BC-2800

Auto

Hematology

Analyzer

Service Manual

Copyright

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Phone: +49 40 2513175
Fax: +49 40 255726

Content

Chapter1 Hardware

1.1 General

1.1.1 Schematic

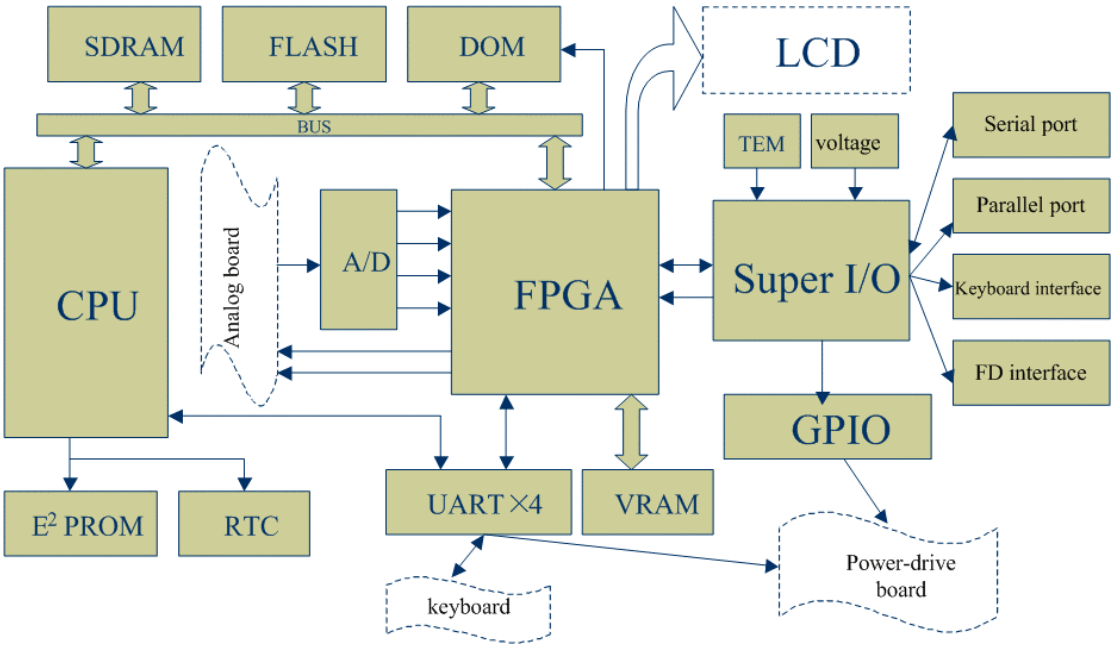


Figure 1-1 Schematic of the CPU board

The CPU, FPGA and Super I/O are the major components on the board. The CPU carries out the instructions and functions as the core of the board. The FPGA functions as the relay between the CPU and the Super IO. The Super I/O includes various interfaces that can be accessed by the CPU through the FPGA. System memories are SDRAMs. The DOM is a Disk-On-Module that stores the system software and test data. The RTC is a real time clock. System configurations are stored in the EEPROM. The VRAM is the memory for video display.

1.1.2 Basic Functions of the CPU Board

To receive such analog signals as the WBC/RBC/PLT counts, HGB measurement, aperture voltage vacuum/pressure signals, etc.

To monitor such system status as the +48V, +12V and -12V supplies of the analog board, the +3.3V and +12V supplies of the CPU board itself and the temperature of the whole analyzer.

To receive the keypad signal and control the keypad buzzer and LCD backlight.

To generate control signals to control the valves, aperture zapping, HGB LED, current source and digital pot.

To drive and turn on the LCD and adjust the contrast.

To drive the keyboard, printer and floppy drive.

1.2 Power Supply

The CPU board is powered by two independent external power supplies, a +5V supply and a 12V supply. Two 5A fuses are respectively installed on the two power entries. The +5V supply is converted a +3.3V supply to power the digital components and the +3.3V supply is also further converted into a +1.5V supply to power the FPGA. The +12.8V supply serves the CPU board only.

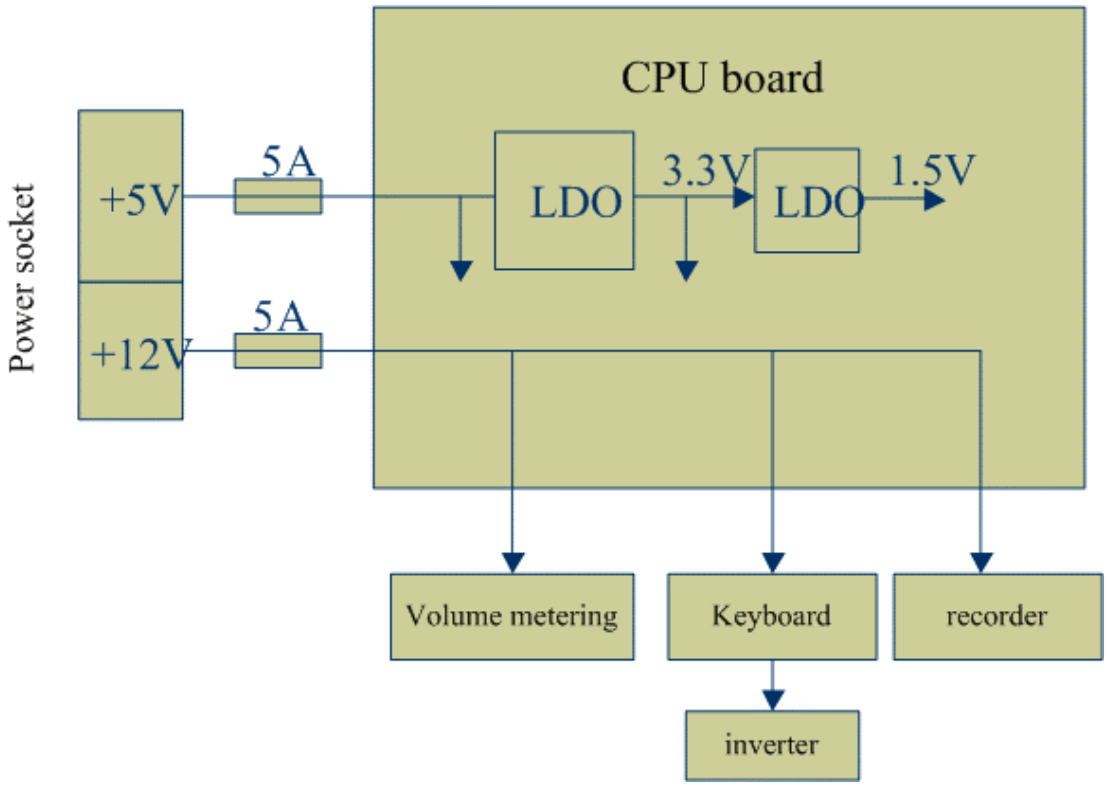


Figure 1-2 Power distribution of the CPU board

1.3 RTC

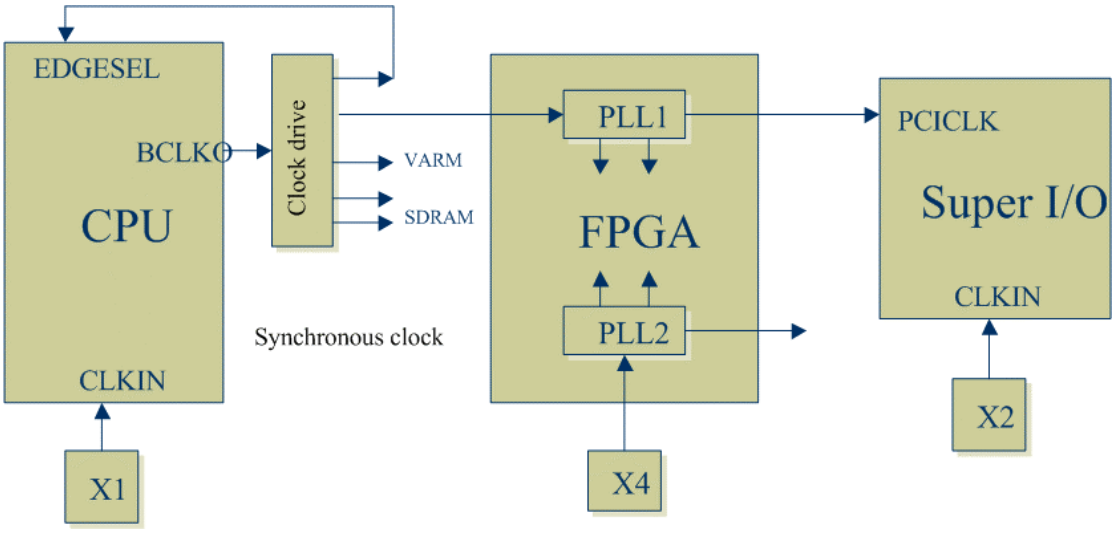


Figure 1-3 Arrangement of the CPU Clock

The X1, X4 and X2 are external crystal oscillators whose frequencies are 45MHz, 45MHz and 24MHz respectively. The clock output of the CPU, BCLKO, is main clock signal of the CPU board.

1.4 CPU and Peripheral Devices

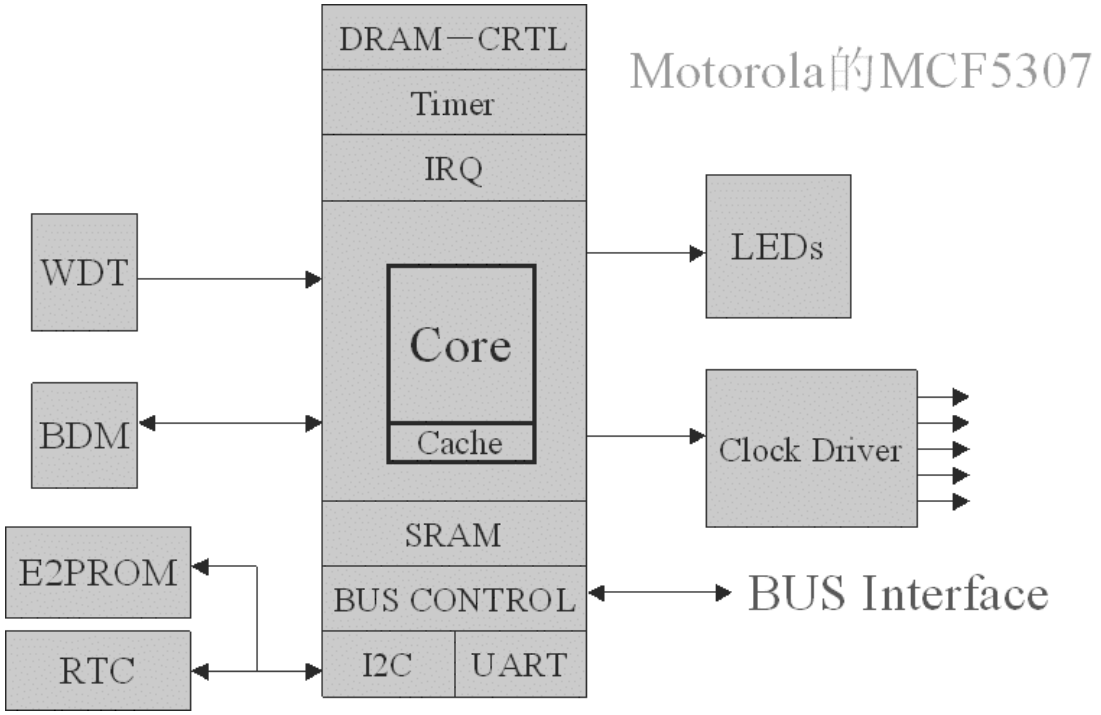


Figure 1-4 CPU and peripheral devices

1.4.1 CPU

- The CPU is MOTOROLA MCF5307 (external frequency 45MHz; operation frequency 90MHz; processing speed as high as 75MIPS).
- The MCF5307 features a 32-bit data bus and a 32-bit address bus. The board uses a 24-bit addressing mode, reserving the most-significant 8 bits as the general purpose I/Os for the FPGA.
- The MCF5307 can be tuned through the BDM port (J18 of the CPU board).
- The CPU board utilizes the built-in I^2C and UART controllers of the MCF5307 to use the EEPROM and RTC as expanded serials ports.
- The CPU boards utilizes the built-in DRMA controller of the MCF5307 to use the 2×8M SDRAM as the expanded memory.

1.4.2 WDT

The Watch-Dog-Timer (WDT) is TI TPS3828. It monitors the running of the software. The CPU must send a feedback to the WDT every 1.6s, otherwise the WDT will force the CPU to restart.

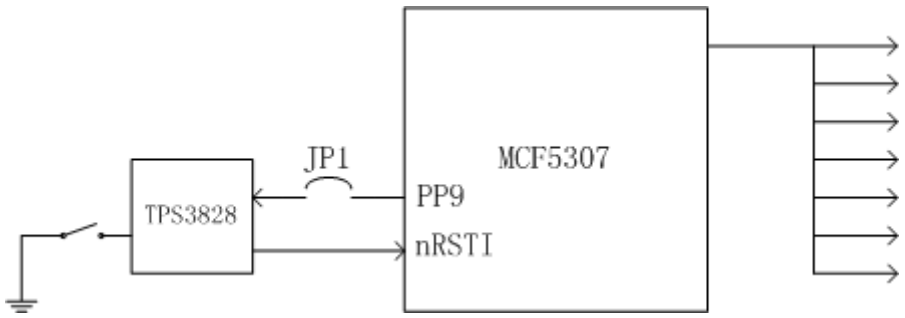


Figure 1-5 WDT

1.4.3 FLASH

The FLASH is TE28F160(2M bytes) . The boot program is stored in the FLASH, so the FLASH is also called the BootROM. Every time the system is powered on, the CPU first executes the boot program that initializes the system and loads the control software from the DOM. The FLASH also contains such information as the FPGA configuration, FPGA version and LCD contrast.

1.4.4 SDRAM

The system memory consists of two 8M-byte memories.

1.4.5 DOM

The CPU board uses a 32M DOM that is powered by a 3.3V supply (the DOM can also be supplied by 5V supply). The DOM is only operational after the FPGA is configured.

1.4.6 RTC

The CPU board uses a real time clock (RTC) to record the time. The RTC is connected to the I^2C bus of the CPU board and synchronized by a 32.768KHz crystal oscillator. When the analyzer is powered on, the RTC is powered by the CPU board; when the analyzer is powered off, it is powered by the built-in battery.

1.4.7 EEPROM

The CPU board uses an 8K byte EEPROM to store such information as system configurations and settings. It is connected to the I2C bus of the CPU and can be written by CPU on-line.

1.4.8 LEDs

When D1 is on, it means +3.3V is functioning properly. When D9 is on, it means +12.8V is functioning properly. When D5 is on, it means the system is

reading or writing the DOM. When D7 is on, it means the FPGA has been configured and is functioning properly. When D20 is on, it means the FPGA is restarting; The D11～D18 indicate the system status as defined by the software.

1.5 Analog Inputs and Outputs

1.5.1 Signals of Blood Cell Counts

The CPU board has three A/D converters, U10 (AD7928), U11(AD7908) and U14 (AD7908). Both the AD7928 and AD7908 feature 8-channel and 1MSPS, only the former is 12-bit converter and the latter 8-bit. The U10 is actually installed and powered by a 2.5V supply, while the U11 and U14 are reserved. The sampling speed is set to 500KSPS.

1.5.2 Signals of System Monitoring

The Super I/O monitors such system status as the +48V, +12V and -12V supplies of the analog board, the +3.3V and +12V supplies of the CPU board itself and the temperature of the whole analyzer.

1.5.3 Signals of LCD Contrast

The Super I/O generates PWM signals that are then integrated to output a 0~2.5V analog signal to control the LCD contrast. The user can adjust the contrast through the software interface.

1.6 Digital Inputs and Outputs

1.6.1 Serial Port

The analyzer has 6 serial ports, which are illustrated in Figure 1-6.

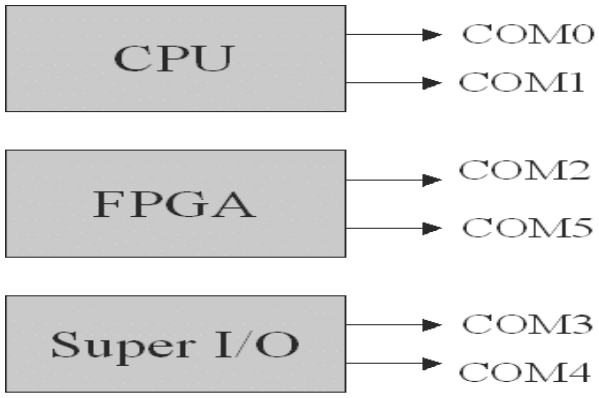


Figure 1-6 Serial ports

The CPU incorporates 2 UART controllers (3.3LVTTL), one to control the motor of the driving board and the other communicates with the recorder (powered by 5VTTL). The FPGA implements 2 UART (3.3VTTL), one to connect the keypad and the other reserved to control the pump. Another 2 UARTs (RS232) are implemented inside the Super I/O to connect the scanner and to communicate with the PC.

1.6.2 Parallel Port and PS/2 Port

The Super I/O provides a DB25 parallel connector to connect to connect a printer or a floppy drive (the power supply of the floppy drive is supplied by the PS/2). The software will automatically adapt to the connected printer or the floppy drive.

The Super I/O provides a keyboard interface and a mouse interface (COM3 and COM4). Note that the BC-2800 does not support the mouse yet.

1.6.3 GPIOs

1 Signals of the Start key

The FPGA detects the input signal, which will turn low when the Start key is pressed.

2 Volumetric metering Signals

The FPGA detects the signals sent by the start transducer and the end transducer.

3 Signals of level detection

The BC-2800 has not level sensors

4 Digital pot

The SPI bus interface implemented by the FPGA controls the 4 digital potential-meters on the analog board to control the HGB gain.

5 Signals controlling valves and pumps

The Super I/O outputs 20 control signals to control the valves and pumps through the driving board. Since the BC-2800 only has 1 pump and 11 valves, the redundant lines and ports are reserved.

6 Signals controlling bath

The Super I/O outputs 4 control signals (through the analog board) to control the three switches that respectively control the aperture zapping, current source and HGB LED.

7. Others

The Super I/O outputs 2 control signals to control the photo-couplers of the volumetric metering board and the buzzer of the keypad.

1.7 Driving Board

The driving board controls and drives the pumps, valves, and motors.

1.7.1 Basic Functions

The driving board drives the valves, pumps and motors. It carries out the following instructions sent by the CPU: to open/close the pumps or solenoid valves; to control the motors of the syringes; to control the movement of the sample probe; to remain the torques of the motors when the analyzer has entered the screen saver.

1.7.2 Basic Blocks

The driving board mainly consists of a power block, switching block and motor control block. See the figure below for the positions of each block of the PCBA.

1.7.2.1 Power block

The power block includes a 5V, 12V and 30V DC supply. The 12V and 30V supply comes from the power interfaces, where two LEDs are installed to respectively indicate the whether the 12V or 30V supply is connected. When the LED is on, it indicates the corresponding power has been connected to the driving board. The MC7805T converts the received 12V supply into the 5V supply, as the following figure shows.

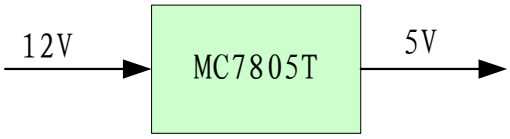


Figure 1-7 How the 5V power is obtained

1.7.2.2 Switching block

The switching block mainly consists the photocoupling circuit and driving circuit of the pumps and valves, as the figure below shows.

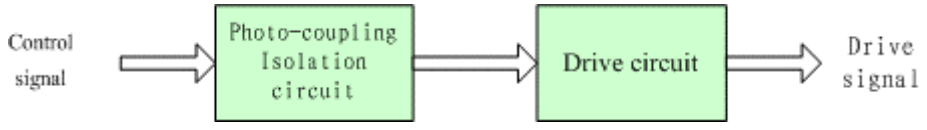


Figure 1-8 Switching control circuit

1. Photocoupling circuit

The photocoupling circuit mainly consists of the photocoupler and resistors. It provides 16 TTL outputs to the valves and pumps. The photocoupler,

TLP521-2, isolates the digital ground from the driving ground.

2. Driving circuit of valves and pumps

The driving voltage of the valves and pumps are 12V (TTL). The circuit mainly consists of ULN2068. In the BC-2800, the circuit can maximum drives 14 valves and 2 pumps. The fluidic system decides which pumps or valves are to be actually used.

1.7.2.3 Motor control block

The motor control block includes: serial communication circuit, control/drive circuit of the sample probe mechanism, control/drive circuit of the syringe motor, and drive/signal-detecting circuit of the position sensors.

1. Serial communication circuit

Since the CPU board requires a 3.3V power supply while the driving board requires a 5V power supply, a photocoupler (H11L1) is needed for the purposes of conversion and isolation.

2. Control/Drive circuit of sample probe mechanism

The control/Drive circuit of sample probe mechanism includes the control/drive circuit of the elevator motor and that of the rotation motor. The control system of the sample probe motor consists of a AT89S51 MCU and ADM705 WDT. The AT89S51 also detects the signals coming from the position sensor when controlling the motors.

A. Control/drive circuit of the elevator motor

The circuit includes the control part (a MCU system) and the drive part, as shown in the figure below.

The MCU system provides the sequence signals for the elevator and rotation motors and controls the position sensors, as the figure below shows. The MCU reset signal (RST_XY) is active-high.

The drive part mainly consists of a control device (L6506), drive device (L298N) and follow-current device (UC3610). The drive voltage is 30V. The sequence signal and the enable signal of the drive device come from the MCU.

B. Control/drive circuit of the rotation motor

The circuit mainly consists of a control part (MCU system) and a drive part. Refer to the previous introduction for the MCU system. The drive part is the ULN2068B and the drive voltage is 12V. The sequence signal comes from the MCU, as shown in the figure below.

3. Control/drive circuit of the syringe motor

The circuit mainly consists of a control part (MCU system) and a drive part.
The MCU is the P87LPC762 with built-in WDT. The MCU system executes the aspirating and dispensing operation of the syringe and detects the signals sent by the position transducers.
The drive part is similar to that of the elevator motor. See the block diagram above for details.

4. Drive/signal-detection circuit of the position transducers

The control system judges the motor positions by the signals sent by the position transducers (photocouplers). The photocouplers are driven by the MCU through a 74LS07. The photocoupler sends the position signals to the MCU through a 74LS14 (inverter). See the figure below for the block diagram of the position-detecting circuit. The photocouplers are installed on the sample probe assembly and the syringe assembly and feed the control and feedback signals to the driving board through cables.

1.7.2.4 Testable Signals

To test the signals, connect the grounding terminals of the oscillator and the multi-meter to the DGND or the PGND.

The testable signals are: control signals of valves and pumps, sequence signals of the motors, valves, position signals sent by the position transducers, serial communication signals, reset signals and voltage signals of the power supplies.

1.8 Display Unit

1.8.1 Function of the Adapter

The LCD adapter connects the LCD to the CPU board.

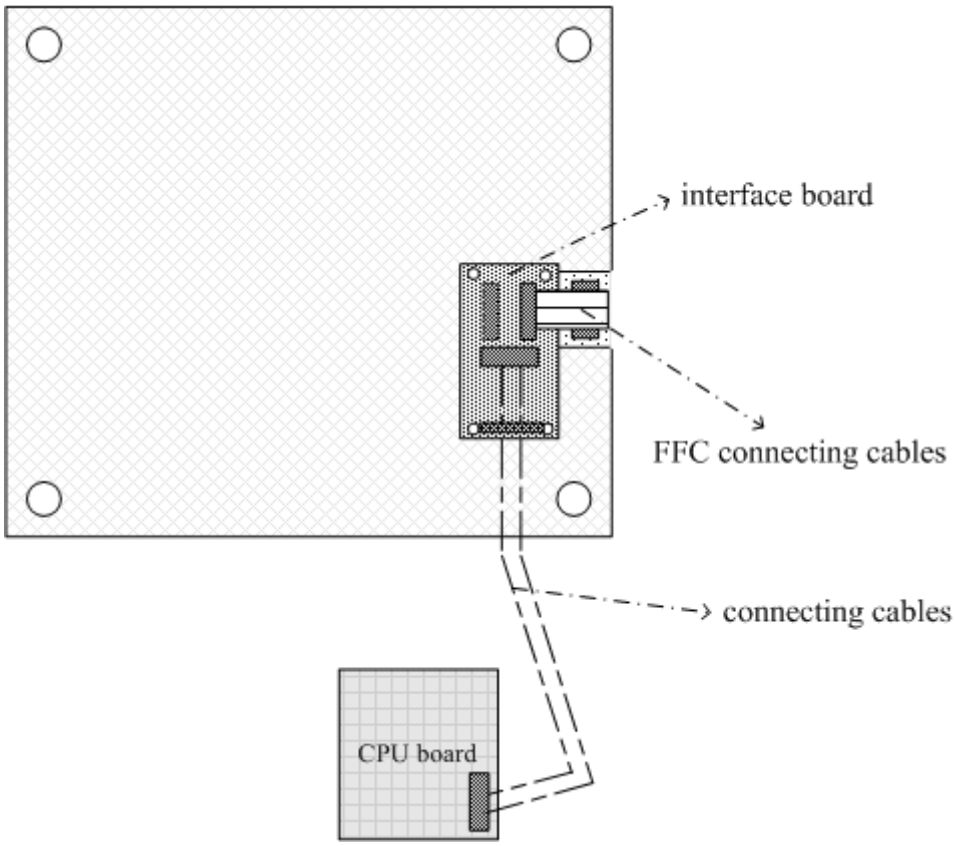


Figure 1-9 Connection Schematic

1.8.2 Introduction of the adapter

The adapter incorporates two FPC/FFC connectors, J2 and J3. The J3 is for the BC-2800 display while the J2 is reserved for other Mindray analyzer. Only the J2 is installed for the BC-2800. The J1 serves to connect the LCD signal cable.

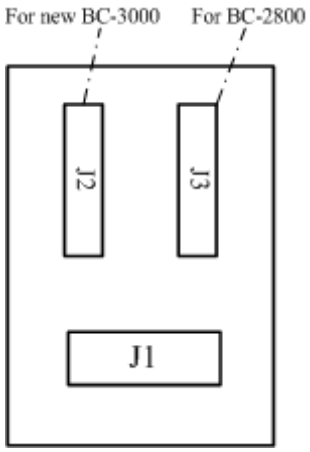


Figure 1-10 Schematic of the adapter

1.9 Functions of the Keypad Adapter

1. To scan the keypad

   The keypad adapter scans the keypad and reports the scanned key code to the main board.

2. To control the LCD brightness

   The keypad adapter receives the instructions from the main board to turn on/off the backlights and power indicator of the LCD and to control the brightness of the backlights.

3. To control the buzzer

   The keypad adapter receives the instructions from the main board to turn on/off the buzzer.

1.9 .1 Architecture of the Adapter

The adapter mainly consists of a MCU, keypad matrix, backlight control, power indicator control and buzzer.

1.9.2 Detailed Description

1.9.2.1 Power supply

The main board provides a +12V and 3.3V supplies, which are isolated from each other. The 3.3V supply is the main power of the adapter and the +12V is passed to the backlight board (inverter) of the LCD and also converted to a 5V supply to drive the buzzer and controls the on/off of the backlight power the adapter. Since the 3.3V and +12V are isolated, the MCU send the control signals to the buzzer and backlight board through photocouplers.

1.9.2.2 MCU

The MCU is AT89C2051 whose resetting time is 470ms. It uses a 11.0592MHz crystal oscillator.

1.9.2.3 Keypad scanning

The keypad matrix is 5X4 one, incorporating 9 I/O wires and 20 keys. Note that the keys at line 5 and columns 3 and 4 are not used.

1.9.2.4 Backlight control

The keypad adapter shuts off the backlight and blinks the power indicator when instructed by the main board to do so (usually after the analyzer entered the screen saver). The backlight board uses an independent 12V power supply and receives the control signals through photocouplers. The transistor is used to help control the LED so that the power indicator can be turned on even when something is wrong with the MCU.

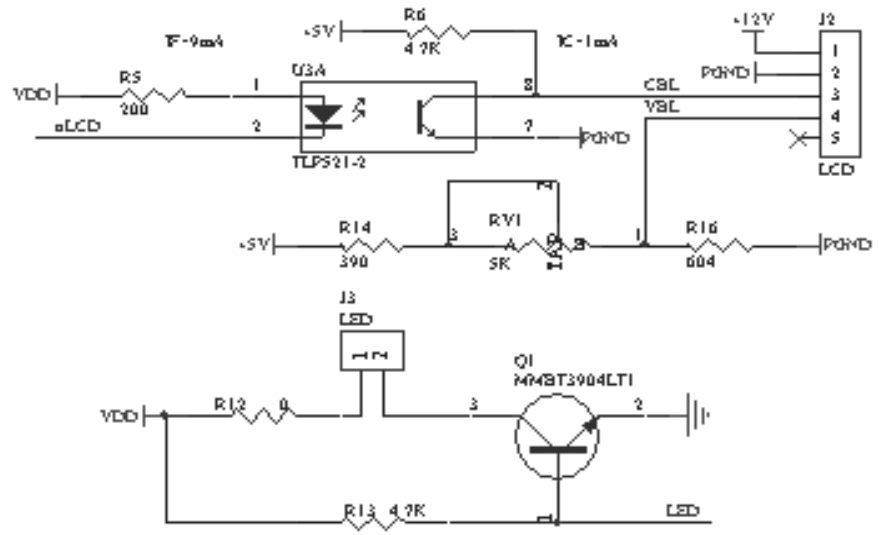


Figure 1-11 Control of LCD brightness

The LCD brightness is controlled by pot RV1. Adjusting the RV1 can force the VBL to change within 0.5~3V. The voltage change is fed into the inverter and causes the change of the drive current and hence the change of the brightness. Note that the smaller the voltage and the brighter the LCD.

1.9.2.5 Buzzer control

The buzzer is controlled by a DC signal (5V DC; current<40mA). The 5V supply of the buzzer is isolated from the VDD and the control signal is received through a photocoupler （TLP521-2）that is controlled by a current around 10mA.

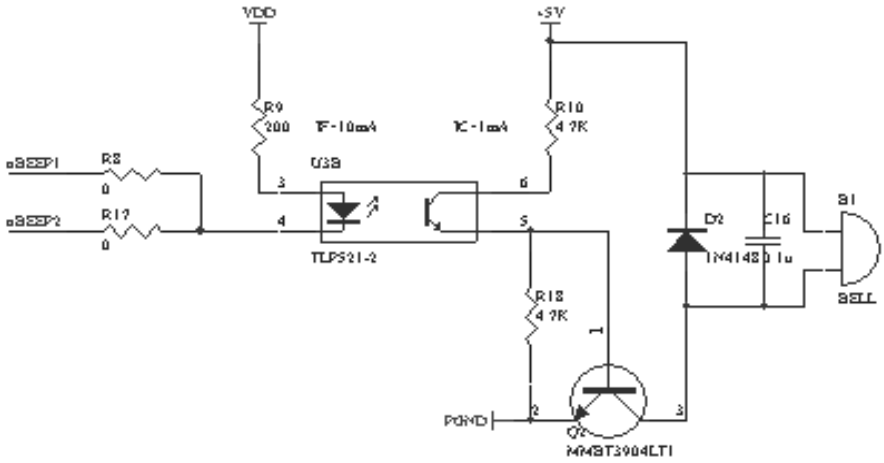


Figure 1-12 Buzzer control

Chapter2 Fluidic System

2.1 Fluidic system

1. prepares diluent for the whole blood and prediluted modes
2. counts blood cells and measures HGB concentration
3. dispenses diluent
4. implements the flush, startup and cleaning cycles
5. controls vacuum/pressure

2.2 Construction of Fluidic System

The fluidic system consists of a sample probe assembly, syringe assembly, pump assembly, volumetric metering unit, right valve panel and front panel.

2.2.1 Sample Probe Assembly

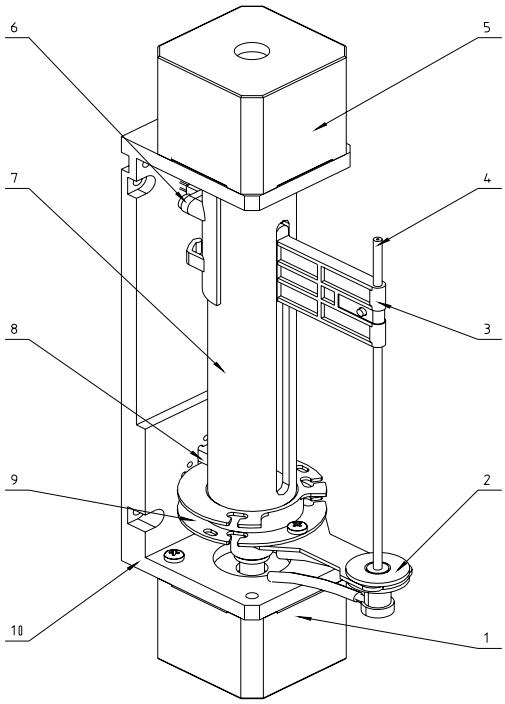


Figure 2-1 Sample probe assembly

No.	Name
1	Rotation motor
2	Probe wipe
3	Probe holder
4	Sample probe
5	Elevator motor
6	Upper photo-coupler
7	Sleeve
8	Left and right photo-couplers
9	Retaining ring
10	Mount

2.2.2 Syringe assembly

2.2.3 Pump Assembly

2.2.4 Volumetric metering unit

2.2.5 Right valve panel and front panel

See Chapter 3 Disassembling Instructions.

2.3 Composition of Fluidic System

The fluidic system consists of the following subsystems: sensor subsystem, bath subsystem, lyse dispensing and mixing subsystem, diluting subsystem, volumetric metering subsystem, vacuum subsystem, pressure subsystem and auxiliary subsystem.

The key components of the fluidic system are the solenoid valve, syringe, aperture, sample probe, pump, bath， metering tube, probe module, negative/positive pressure chamber and hose.

The solenoid valve is ASCO458. Totally 11 valves are used, 7 three-way valves and 4 two-way valves.

The two syringes, 10mL and 50uL, are made by Mindray.

The aperture is Ø80.

The sample probe has two layers and its surface is polished, making the probe easy to clean.

2.4 Functional modules

The fluidic system can be divided into the following functional modules: aspiration/dispensing module, counting module, washing module, hydraulic module, mixing module and waste discharging module. See the figure below for the interaction of these modules.

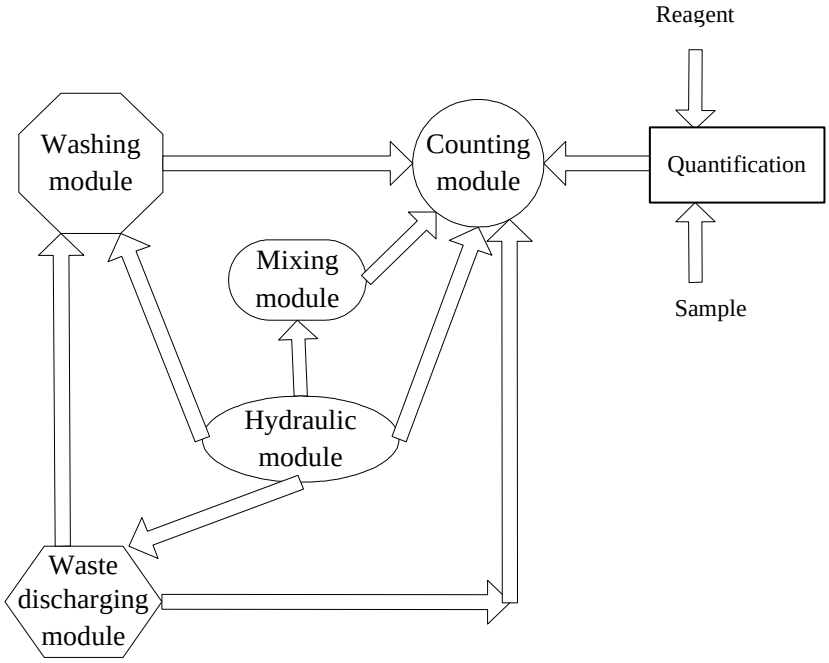


Figure2-2 Interaction of the functional modules

2.4.1 Aspiration/dispensing module

The aspiration/dispensing module includes a motor that drives the 50 uL and 10 mL syringes, the former for aspirating/dispensing the whole blood sample and the latter for aspirating/dispensing the prediluted sample, diluent and lyse. See the figure below for details.

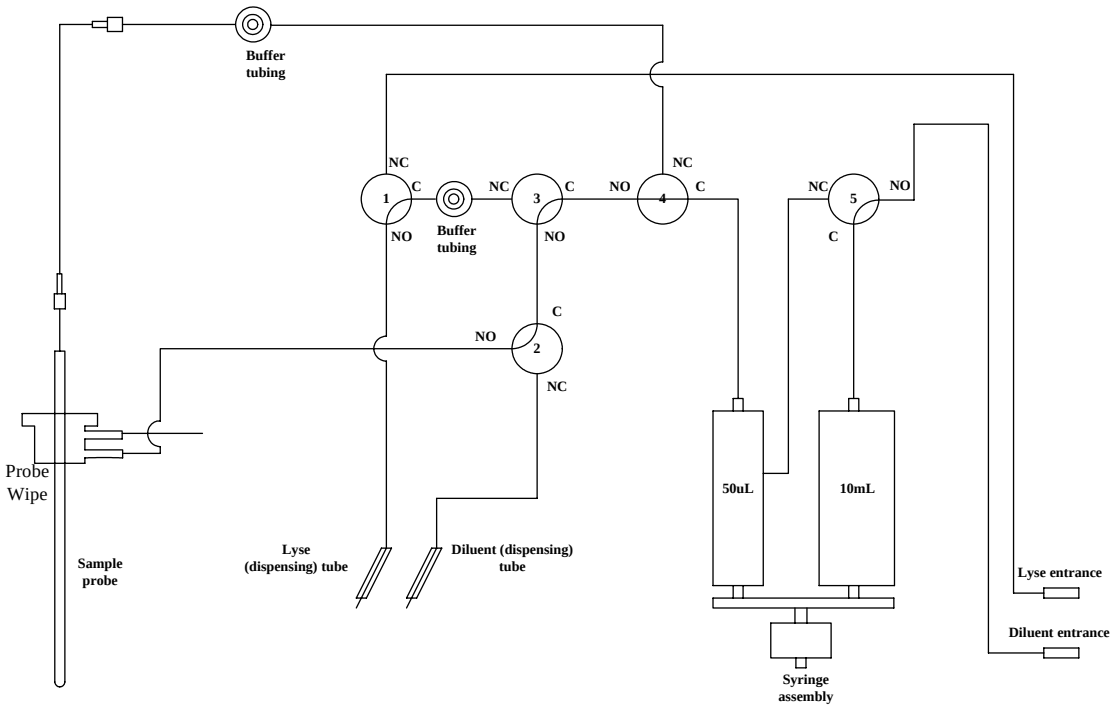


Figure 2-3 Aspiration/dispensing module

The lyse is aspirated and dispensed into the bath as described below:

The valves 1, 3 and 5 are open and the motor pulls the syringe plunger downward to aspirate certain amount of lyse. The aspirated lyse is stored in the buffer tubing of valves 1 and 3. Then valve 1 is closed and the motor runs reversely to push the syringe plunger upward to dispense the stored lyse into the bath.

Since the capacity of the buffer tubing is far greater than the volume of the aspirated lyse, the lyse will not overflow to the syringes through valves 3 and 4.

Service tip: Note that the length and type of the buffer tubing shall not be changed.

2.4.2 Counting module

The counting module mainly consists of the bath, valve 1 and 2, vacuum filter, metering tube, negative pressure and other supporting components, as figure below shows.

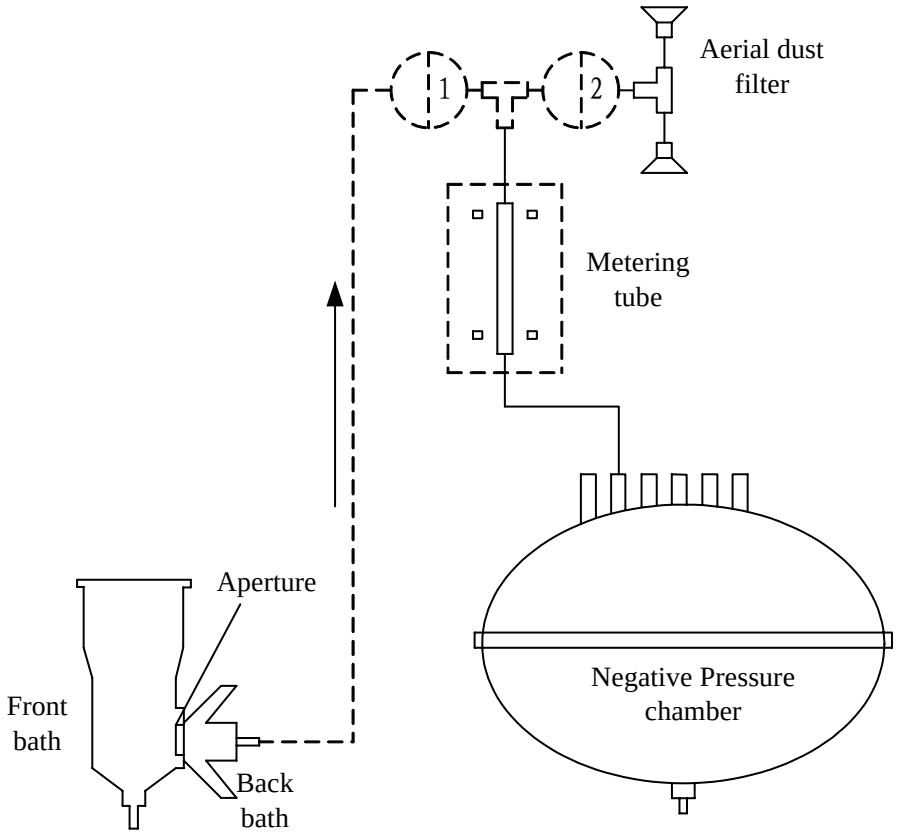


Figure2-4 Counting module

The counting module is implements the most important function of the analyzer - counting. The electrodes installed on the bath detect the pulses caused by blood cells passing the aperture. The detected pulses are then sent to the analog board to be amplified, rectified, recognized, adjusted and counted.

When the sample is mixed in the bath, valve 2 is open and the negative pressure chamber introduces the atmospheric air to pass through the filter and valve 2 and then to flush the metering tube. Valve 1 is open when the vacuum has been established and the sample (blood cells) in the bath is drawn through the aperture by the negative pressure to generate the counting pulses. The sample keeps moving to push the rinse between the back bath and metering tube to move through the tube. When the rinse passes the upper optical sensor mounted on the metering tube, a start signal is generated and sent to the analog board, which starts the counting right away, and when the rinse passes the lower optical sensor, a stop signal is generated and sent to the analog board, which stops the counting right away.

Volumetric metering：the volumetric metering ensures a relatively objective and stable analysis cycle.

Monitoring of the counting time：the volumetric metering enables the monitoring of the counting time. By monitoring the counting time, the system can easily know whether the aperture is clean or blocked and feed this information to the service personnel in terms of the aperture voltage so that they can service the

analyzer in time.

2.4.3 Washing module

The flushing module includes: washing the exterior and interior of the sample probe; washing the front and back bath; flushing the aperture and flushing the fluidic lines.

2.4.3.1 Washing exterior and interior of sample probe

The part that washes the sample probe is shown in Figure2-5. The washing consists of two procedures – washing the exterior and washing the interior.

1. To wash the exterior：The plunger of the 10mL syringe moves downward to aspirate diluent from the NO end of valve 6. Then the plunger moves upward and valves 6 and 5 are open so that the aspirated diluent is dispensed, through the NC end of valve 6, NC end of valve 5 and valves 4 and 3 to the lower part of the probe wipe. Then the pump functions to open valves 9 and 10 to introduce a negative pressure on the upper part of the probe wipe. Because of this negative pressure, the diluent dispensed to the lower part of the probe wipe is transferred to the upper part and washes the exterior through the up-and-down movement of the sample probe.
2. To wash the interior：The plunger of the 10mL syringe moves downward to aspirate diluent from the NO end of valve 6.Then the plunger moves upward to dispense the aspirated diluent, through valves 5 and 6 and the buffer tubing, to the sample probe to wash the interior.

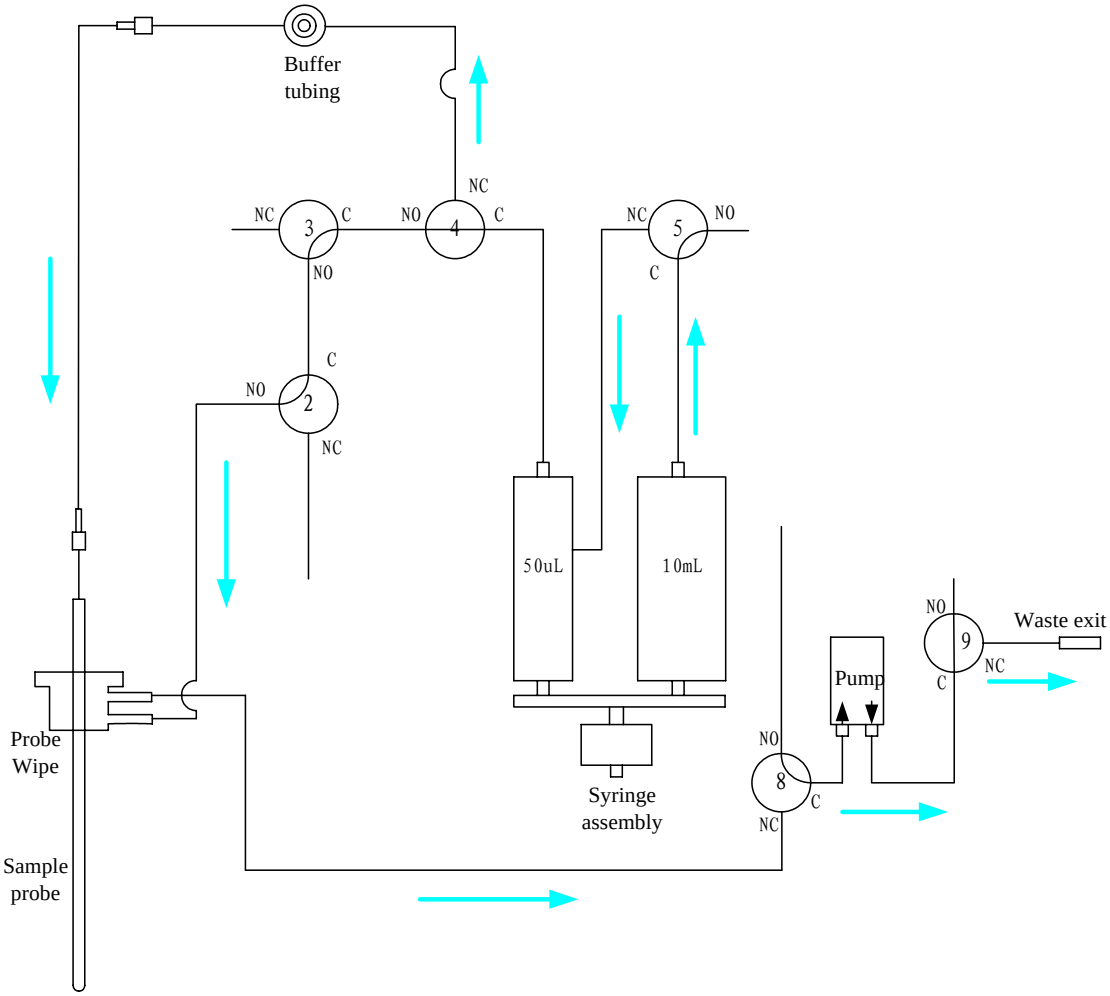


Figure2-5 Washing module（washing of sample probe）

2.4.3.2 Washing of the front and back baths

The part that washes the baths are shown in Figure2-6. The washing consists of two procedures: washing the front bath and washing the back bath. The front bath is washed by diluent and the back bath by rinse. The diluent and the rinse are different and cannot replace each other.

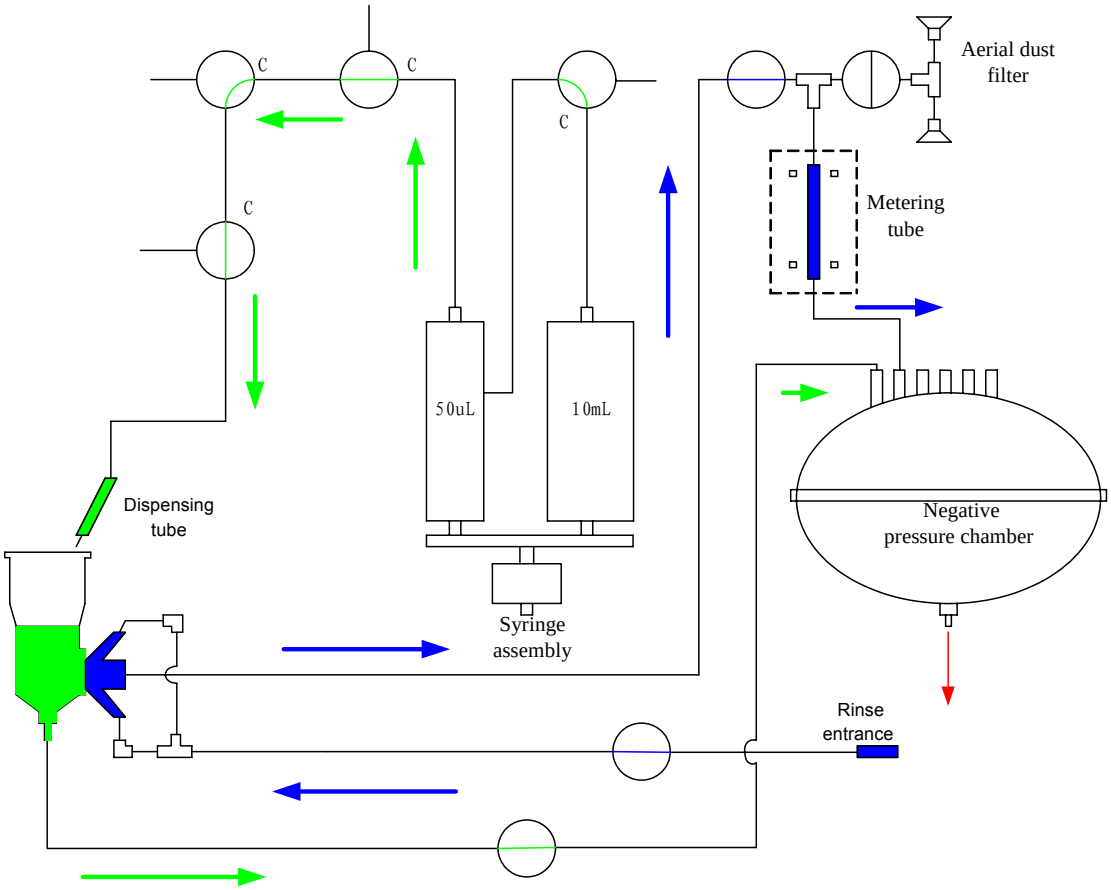


Figure2-6 Washing module of fluidic system（washing of front and back baths）

2.4.4 Hydraulic module

The hydraulic module is shown in Figure2-7. This module serves to establish the vacuum and the positive pressure.

To establish the positive pressure：When both valve 1 and the pump are open, the pump sucks atmospheric air into it, through the upper port and the NC end of valve 1. The sucked pressure is stored in the pressure chamber to establish the positive pressure. The pressure value is monitored by the pressure sensor.

To establish the vacuum: When both valve 2 and the pump are open, the liquid and air in the pressure chamber is expelled to the outside through the NO end of valve 1 and the pump and the NC end of valve 2 to establish the vacuum. The pressure value is monitored by the pressure sensor.

The pump is an imported American product, whose P/N is 3001-10-07252.

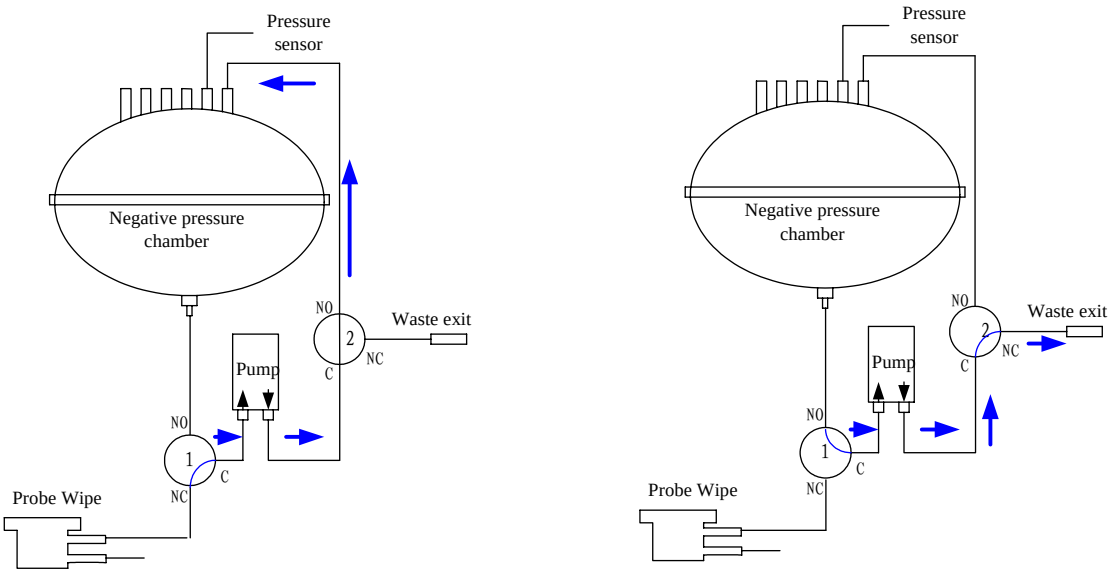


Figure2-7 Pressure/vacuum module

（the left establishes the pressure; the right establishes the vacuum）

2.4.5 Mixing module

The types of mixing is available: mixing by the horizontal movement of the sample probe and bubble mixing. As Figure2-8 shows, the aspirated sample needs to be diluted before the counting. Once the sample is dispensed into the bath containing certain amount of dilute, the system will inform the mixing module to work. Then the sample probe initiates a mild horizontal movement inside the bath and the positive pressure is established inside the pressure chamber. The valve is then open briefly and separate the air in the pressure chamber into several air segments and expel them into the bath to introduces bubbles. The bubbles pop up from the bottom of the bath and the mixing is done thus.

The on/off interval of the valve is critical to effect of the bubble mixing. Either too many or too few bubbles will affect the mixing. During the mixing process, the airway should be well drained, or the trapped liquid will affect the quantity of the bubbles as well as the dilution.

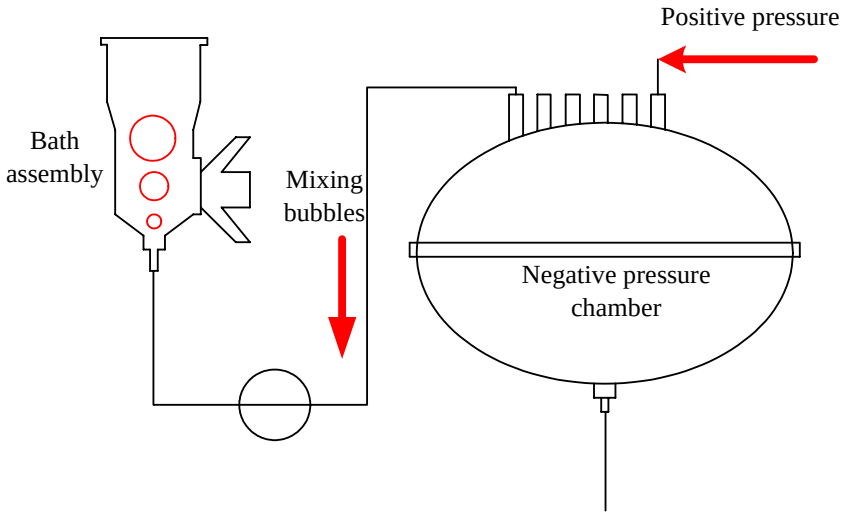


Figure2-8 Mixing module

2.4.6 Waste discharging module

The waste discharging includes: discharging waste of the probe wipe; discharging the waste of the bath; discharging the waste of pressure chamber. As Figure2-9 shows, once the negative pressure is established inside the pressure chamber, valve 11 will open to discharge the waste of the bath to the outside through the pressure chamber and the pump. Likewise, the waste of the probe wipe is discharged to the outside when valves 9 and 10 are open.

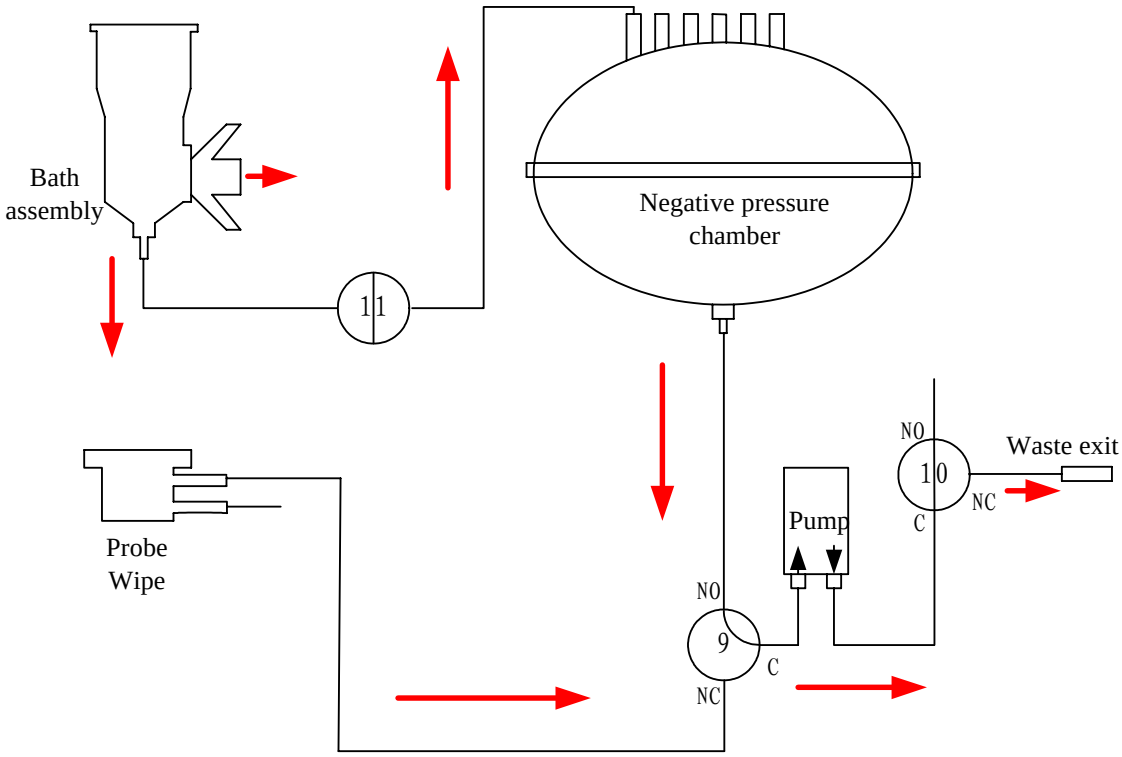


Figure2-9 Waste discharging module

2.5 Counting Procedure

2.5.1 Dilution

Usually in blood samples, the cells are too close to each other to be identified or measured. For this reason, the diluent is used to separate the cells so that they are drawn through the aperture one at a time as well as to create a conductive environment for blood analysis. This analyzer can process two types of blood samples – whole blood samples and prediluted blood samples.

2.5.1.1 Whole blood mode

When analyzing a whole blood sample, this analyzer aspirates 13μL of the sample and follow the procedure presented in Figure 2-10 to dilute it before proceeding to the actual analysis.

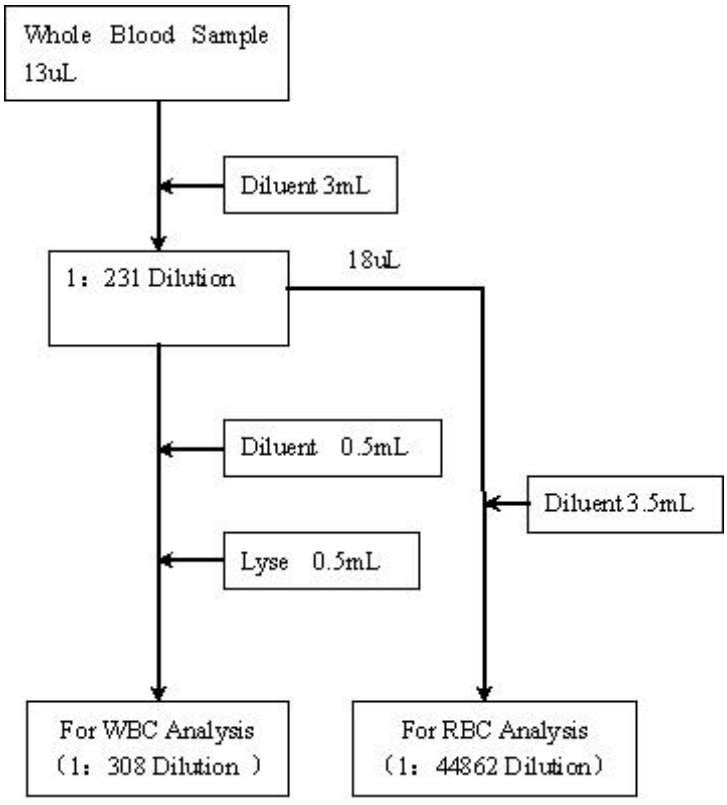


Figure 2-10 Diluting procedure of whole blood mode

2.5.1.2 Prediluted mode

When analyzing a prediluted sample, the operator should first collect 20μL of capillary sample and dispense 1.6mL of diluent from this analyzer to predilute the sample. Then the operator should present the prediluted sample to the analyzer,

which will aspirate 0.7ml of the sample for further dilution, as Figure 2-11 shows.

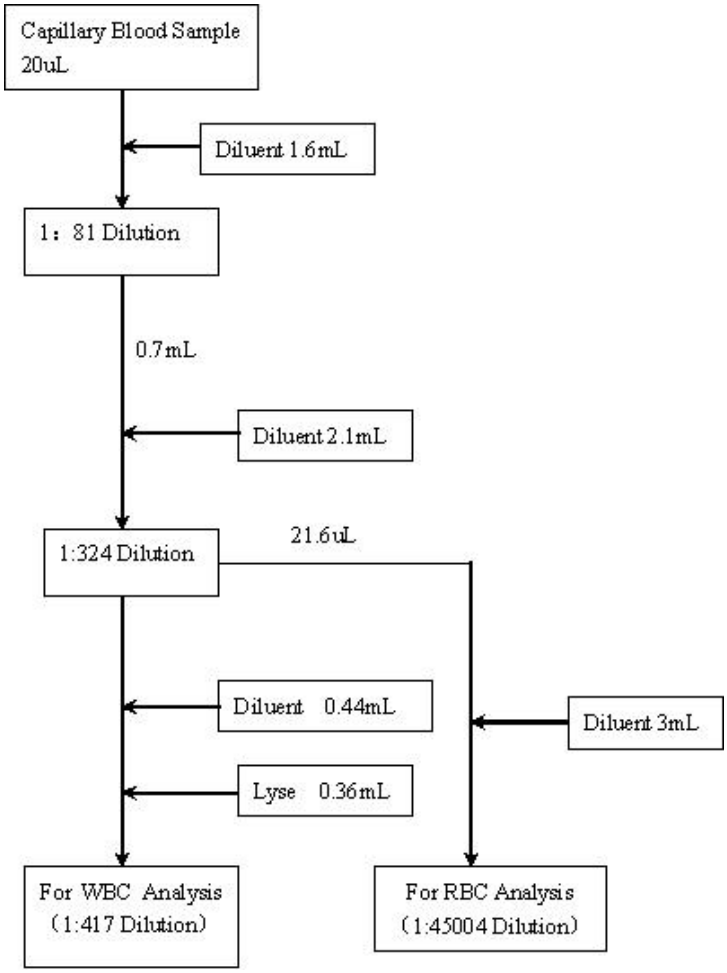


Figure 2-11 Diluting procedure of prediluted mode

2.5.1.3 Volume range of blood cells

After reacting with the diluent and lyse, the cell volumes mainly fall into the following ranges:

WBC: 30～350 fL
RBC: 25～250 fL
PLT: 2～30 fL

Chapter3 Disassembling the Analyzer

3.1 Main Unit Structure

3.1.1 **Main user interfaces**

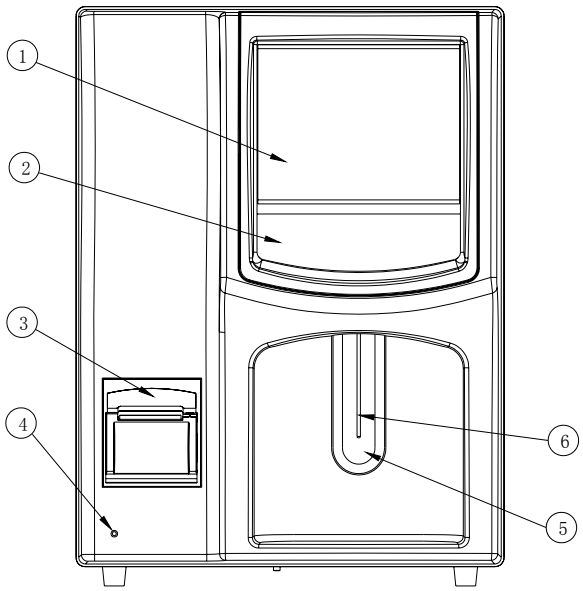


Figure 3-1 Front view

Front view:

1 ---- LCD
2 ---- Keypad
3 ---- Recorder
4 ---- Power Indicator
5 ---- [START] key
6 ---- Sample Probe

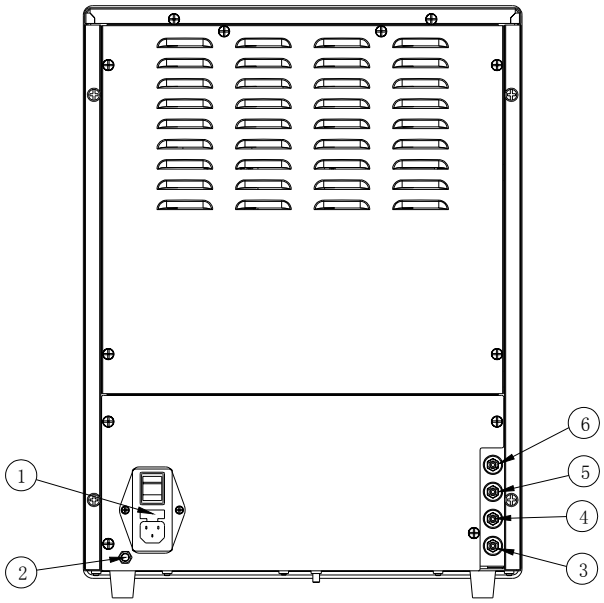
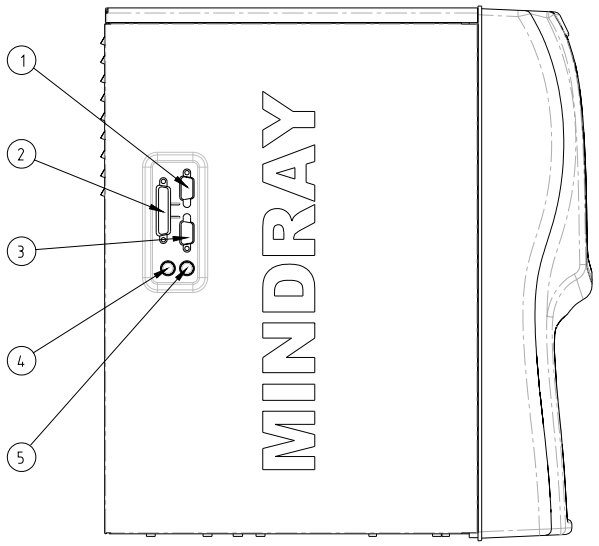


Figure3-2 Rear view

Rear view:

1 --- Power switch
2 --- Equipotentiality
3 --- Waste Outlet (Red)
4 --- Lyse Inlet (Orange)
5 --- Rinse Inlet (Blue)
6 --- Diluent Inlet
(Green)



Left view:

1 --- RS232 Port1
(for the scanner)
2 --- Parallel Port
3 --- RS232 Port 2
(for the computer)
4 --- Power Interface of Floppy Disk Drive
5 --- Keyboard Interface

Figure3-3 Left view

3.2 Disassembling the Main Unit

3.2.1 Removing the left, right and top covers

As the figure below shows, remove the retaining screws (two for each cover) with a Philips screwdriver and pull the covers away.

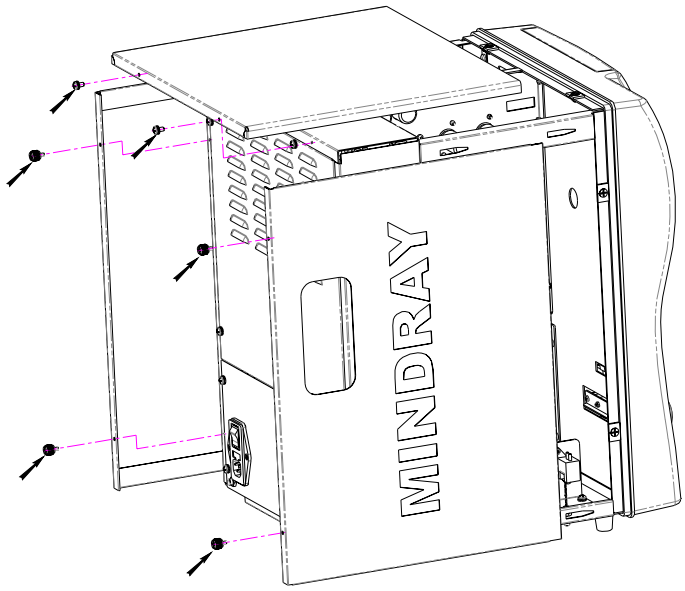


Figure3-4 Removing the left, right and top covers

3.2.2 Removing the back plate and the fixing plate of the power module：

As the figure below shows, remove the retaining screws (totally 10) to remove the plates.

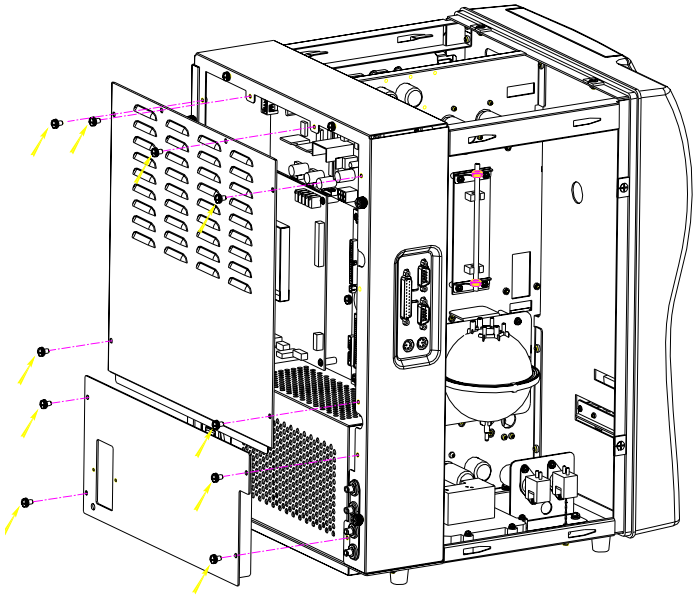


Figure 3-5

3.2.3 Removing the front cover

As the figure below shows, remove the retaining screws (totally 6) to remove the cover.

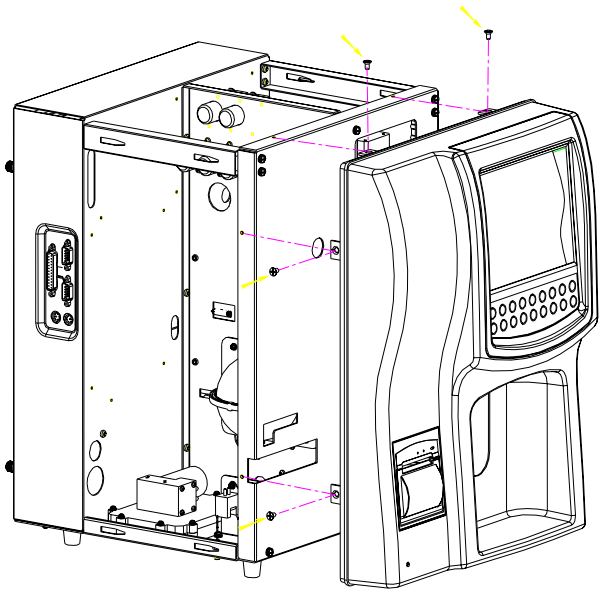


Figure3-6

3.2.4 Removing the LCD assembly

As the figure below shows, remove the retaining screws (totally 4) to remove the assembly.

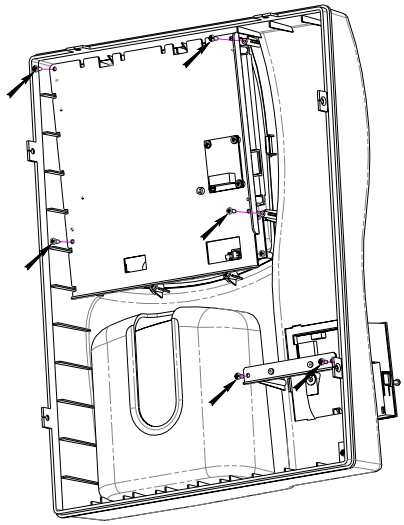


Figure3-7

3.2.5 Removing the keypad

As the figure below shows, remove the retaining screws (totally 7) to remove the keypad.

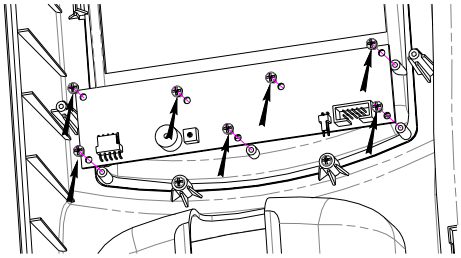


Figure3-8

3.2.6 Removing the LCD and adaptor

As the figure below shows, remove the retaining screws (4 for each part) to remove the LCD and adaptor.

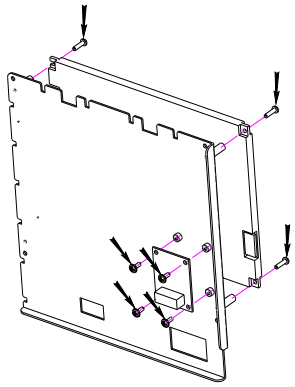


Figure3-9

3.2.7 Removing the power shielding box

As the figure below shows, remove the retaining screws (totally 3) to remove the box.

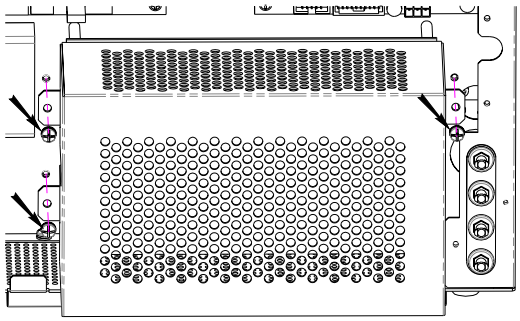


Figure3-10

3.2.8 Removing the driving board, analog board, CPU board and power board

As the figure below shows, remove the retaining screws (totally 18) to remove the boards.

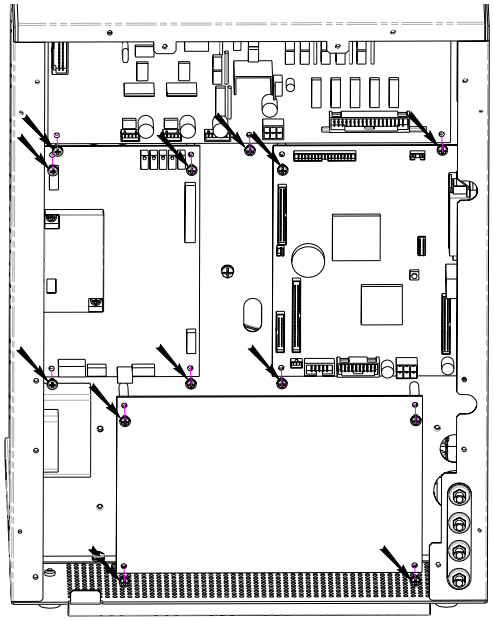


Figure3-11

3.2.9 Removing the transformer

As the figure below shows, remove the retaining screws (totally 2) with a socket wrench.

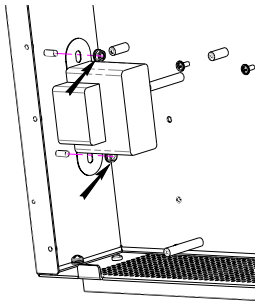


Figure3-12

3.2.10 Removing valves

As the figure below shows, remove the retaining screws (two for each valve) to remove the valves.

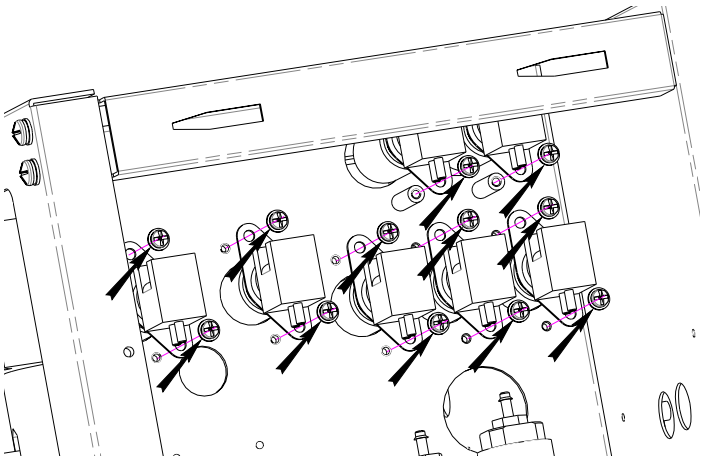


Figure3-13

3.2.11 Removing the sample probe assembly：

As the figure below shows, remove the retaining screws (totally 3) to remove the assembly.

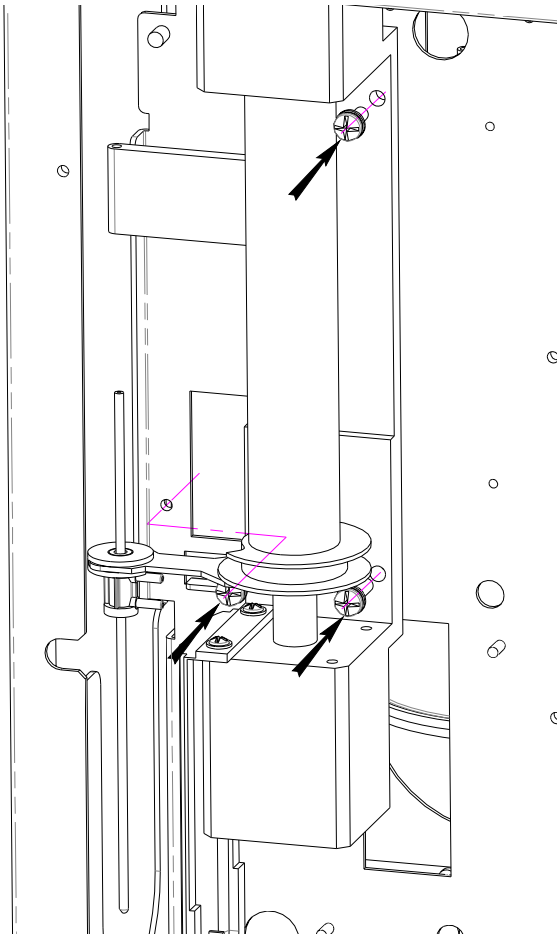


Figure3-14

3.2.12 Removing the syringe assembly

As the figure below shows, remove the retaining screws (totally 4) to remove the assembly.

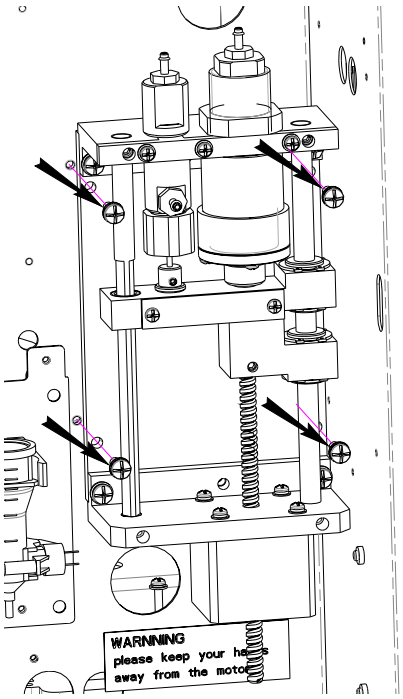


Figure3-15

3.2.13 Removing the vacuum chamber and volumetric metering tube assembly

As the figure below shows, remove the retaining screws (4 for each part) to remove the assembly.

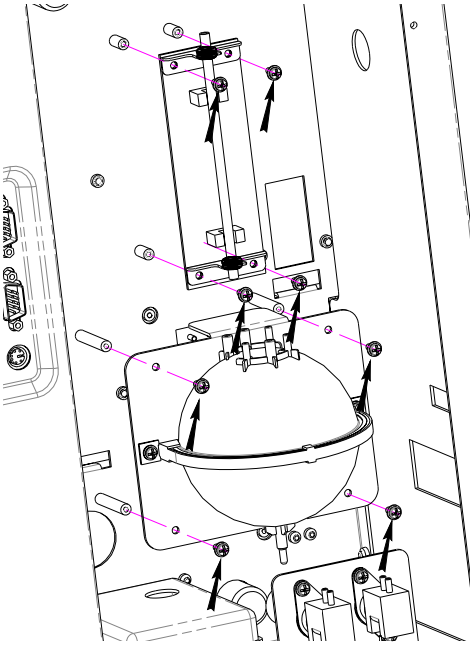


Figure3-16

3.2.14 Adjusting Sample Probe and Replacing Wipe block

The relative position between the sample probe and wipe block has influence on the test results. In the accessory kit, there is a sample probe localizer, as Figure 8-28 shows. You need to use the localizer to adjust the position of the sample probe if you have replaced the wipe block, or observed motor error, or wrong test result. Also, as required by regular maintenance, you should use the localizer to adjust the position of the sample probe monthly.

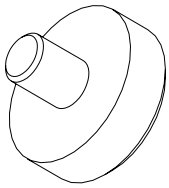


Figure3-17 Localizer

3.2.15 Adjusting Sample Probe Position

Biohazard

Wear standard laboratory attire (including rubber gloves) and follow safe laboratory procedures when handling any material in the laboratory.

Warning

The probe is sharp and may contain biohazard materials, including controls and calibrators. Avoid any unnecessary contact with the probe and probe area.

Follow the steps given below to adjust the sample probe position:

1. Refer to the steps mentioned in section 3.2.1 to remove the right cover of the analyzer.
2. Access the ***Setup→Password*** screen and enter the administrator password to obtain the administrator authority. Access the ***Service→Self-test*** screen.

Press [F1] to select the ***Machine*** group and press [↑] or [↓] to move the cursor to ***Elevator motor,*** as the figure below shows.

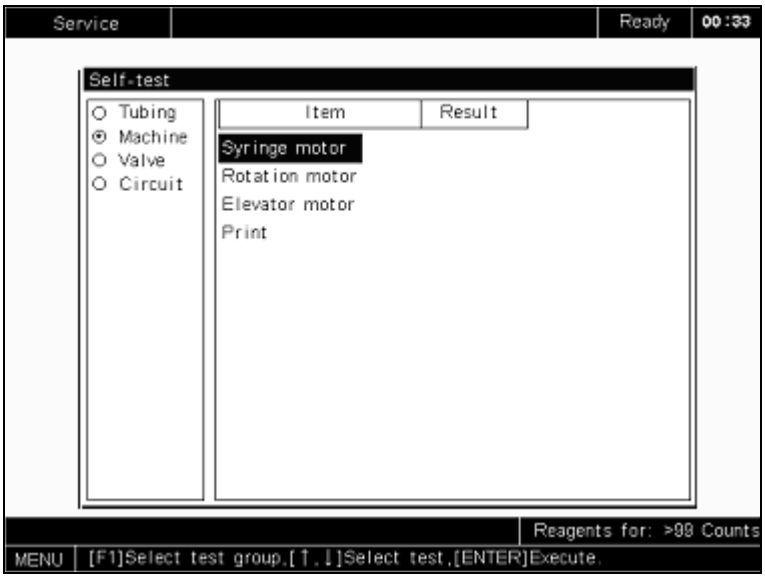


Figure3-18 Accessing elevator motor

Press [ENTER] and an elevator motor screen will pop up, as the figure below shows.

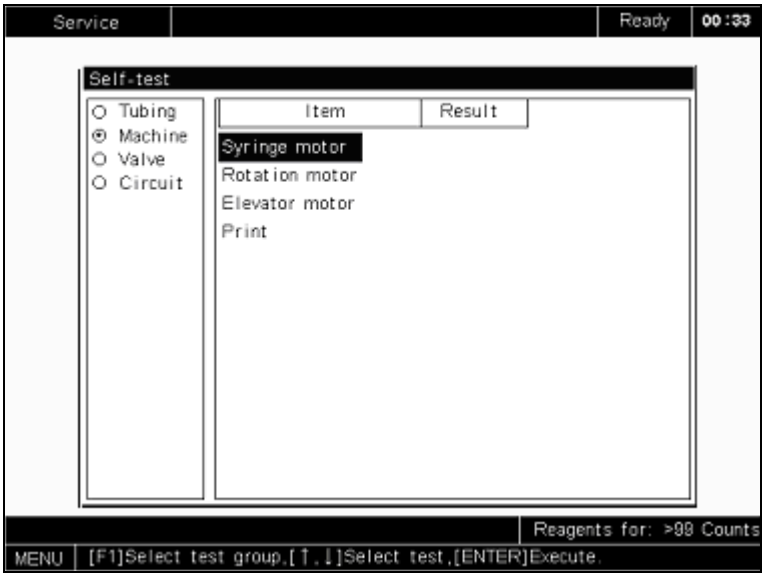


Figure3-19 Elevator motor screen

Press [↑] to move the sample probe upward and press [→] to move the probe to the top of the bath, as the figure below shows.

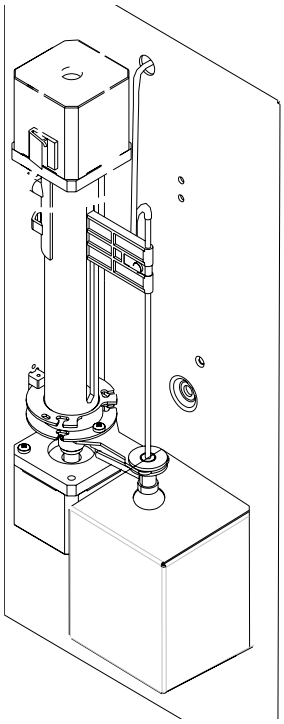


Figure 3-20 Sample probe on the top of the bath

3. Loose the retaining screw by a Philips screwdriver, as the figure below shows.

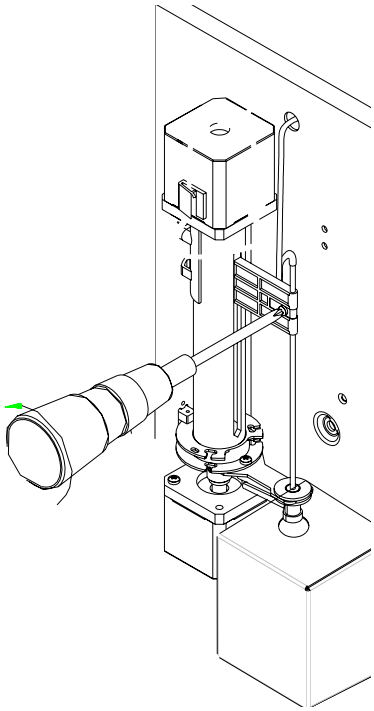


Figure 3-21 Removing screws

4. Remove the probe from the wipe block and insert the localizer into the wipe block from the bottom, as the figure below shows.

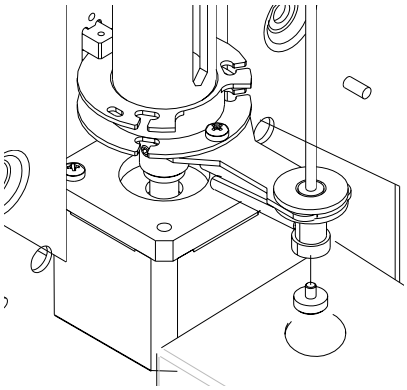


Figure3-22 Insert localizer

5. Insert the probe into the wipe block until it reaches the localizer, as the figure below shows.

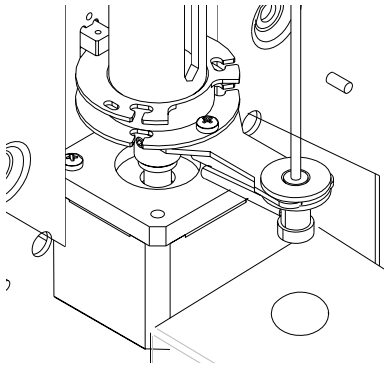


Figure3-23 Inserting sample probe into wipe block

6. Re-tighten the screw to fix the probe and remove the localizer.

3.2.16 Replacing Wipe block

Biohazard

Wear standard laboratory attire (including rubber gloves) and follow safe laboratory procedures when handling any material in the laboratory.

Warning

The probe is sharp and may contain biohazard materials, including controls and calibrators. Avoid any unnecessary contact with the probe and probe area.

Follow the steps given below to replace the wipe block:

1. Follow steps 1~6 according to Section 3.3.1.
2. Pull the loosen sample probe upward until it out of the wipe block, then remove the wipe block and disconnect the tubings from the it (pay attention to the correspondence between the tubings and the connectors), as the figure below shows. Install a new wipe block and connect the tubings (the tubing marked with a black line should connect to the bottom connector). When the connection is done, place the wipe block back to its original position.
3. Follow steps 7~9 according to Section 3.3.1 to fix the sample probe.

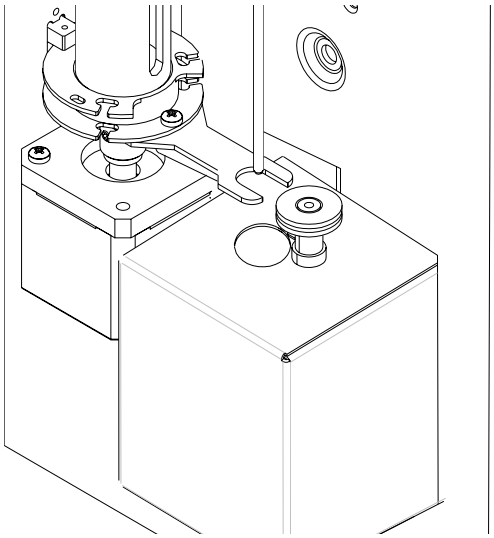


Figure3-24 Installing probe wipe

Chapter4 Histograms and Pulse Graphs

4.1 Histograms

This chapter presents several WBC histograms you may encounter frequently.

1. A normal histogram

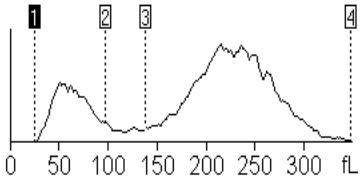


Figure 4-1

NOTE: Blood cells lain between the first and the second discriminators are lymphocyte; those between the second and the third discriminators are mid-sized cells; those between the third and the fourth discriminators are granulocyte. The fourth discriminator is the fixed line.

2. A histogram that is too narrow to indicate the differential result

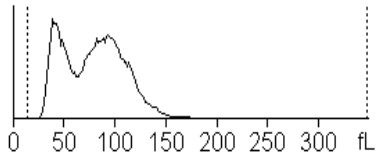


Figure 4-2

3. A histogram that does not show differential result because the WBC result is less than 0.5.

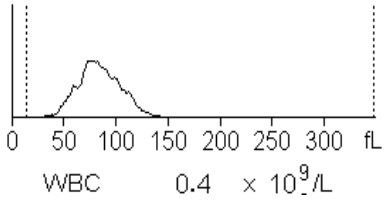


Figure 4-3

4. A histogram that does not show differential result because the peak is in the middle of the histogram.

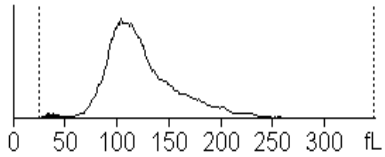


Figure 4-4

5. A histogram that does not show differential result because of increased nucleated erythrocytes, or interference or inadequate hemolysis

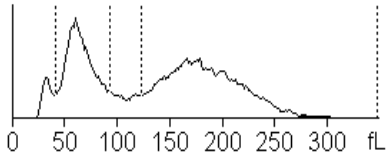


Figure 4-5

6. A histogram that does not show differential result because of severe interference (check the pulse graph to determine whether there is interference) in the WBC channel.

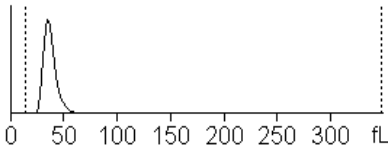


Figure 4-6

7. No lyse reagent or poor hemolysis

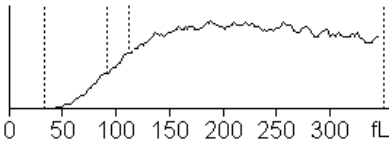


Figure 4-7

8. Increased granulocytes

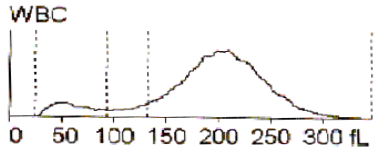


Figure 4-8

9. Increased lymphocytes

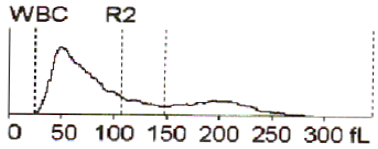


Figure 4-9

10. Tumor patient

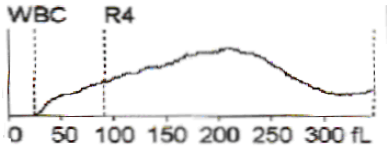


Figure 4-10

11. Increased monocytes

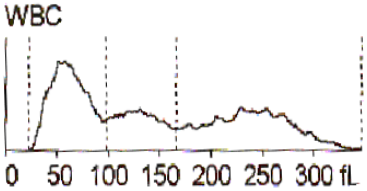


Figure 4-11

4.2 Pulse Graphs

After each count, the system can save the original sampling pulses of this time. We can analyze the reason leading to the fault by viewing these original data.

Common pulse graphs

Enter password “3210”, after a count, you can view the WBC pulse graph of this count by pressing “1” and RBC pulse graph by pressing “2” and PLT pulse graph by pressing “3”. Press “ENTER” to exit.

When the instrument is working normally, the length of pulse data is related to the concentration of the blood sample. The length of the pulse data should be within a limit range. For general samples, the range should be: WBC: < 1M
RBC: < 600K PLT: < 1M

Data length of abnormal sample will not lie in this range.
Length of normal level controls data should be:
WBC：400 ~ 700K RBC：250 ~ 450K PLT：300 ~ 600K

Normal pulse graphs

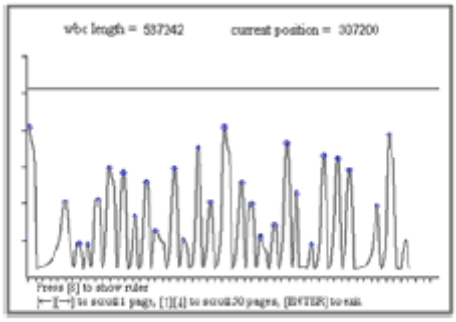


Figure 4-12 WBC pulses

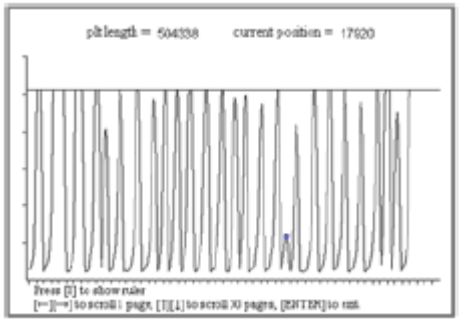


Figure 4-13 PLT pulses

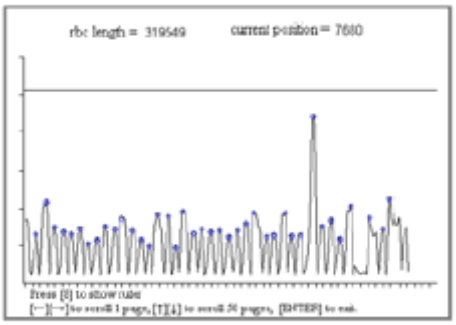


Figure 4-14 RBC pulses

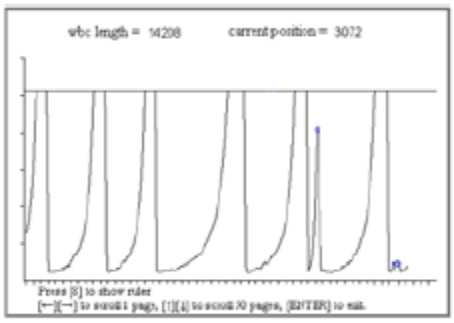


Figure 4-15 Normal WBC background pulse

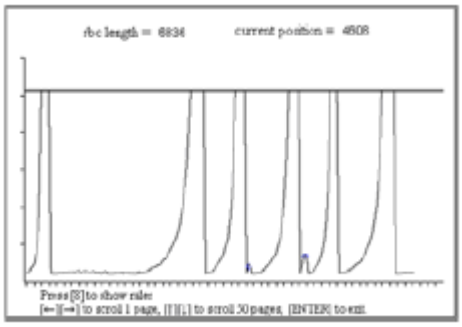


Figure 4-16
Pulse of normal RBC background check

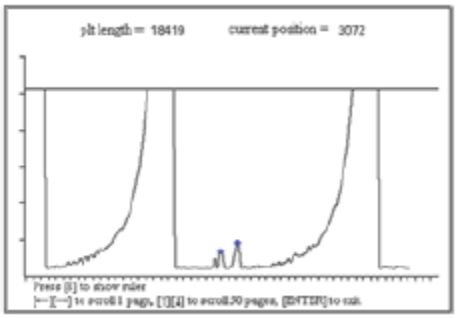


Figure 4-17
Pulse of normal PLT background check

Abnormal pulse graphs

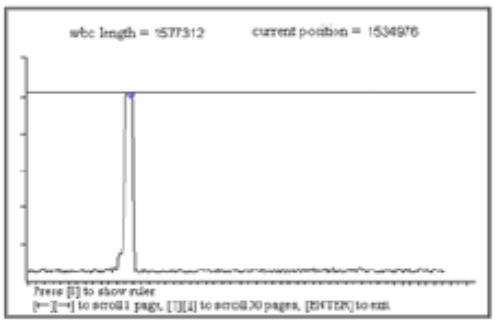


Figure 4-18 Severe interference in WBC channel and data length increases obviously (background)

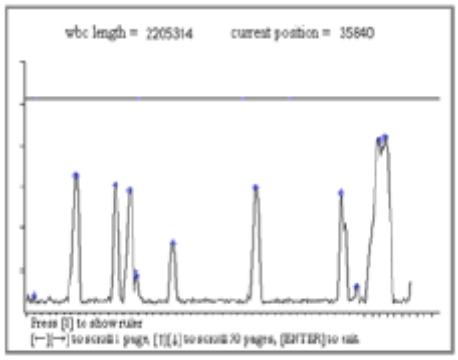


Figure 4-19 Severe interference in WBC channel and data length increases obviously (normal sample)

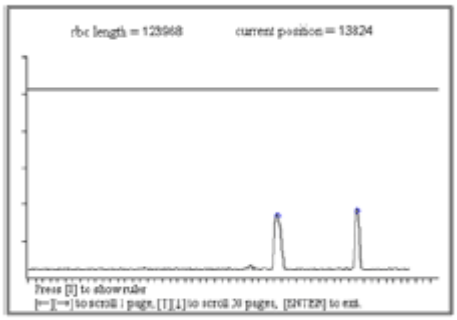


Figure 4-20 Severe interference in RBC channel and data length increases obviously (background)

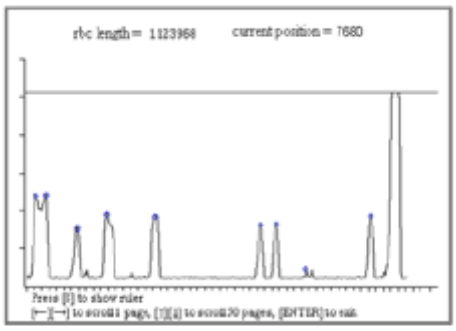


Figure 4-21 Severe interference in RBC channel and data length increases obviously (normal sample)

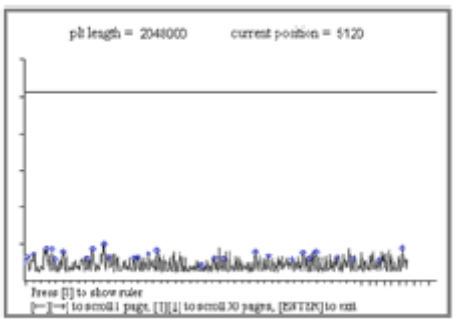


Figure 4-22 Severe interference in P LT channel and data length increases obviously (background)

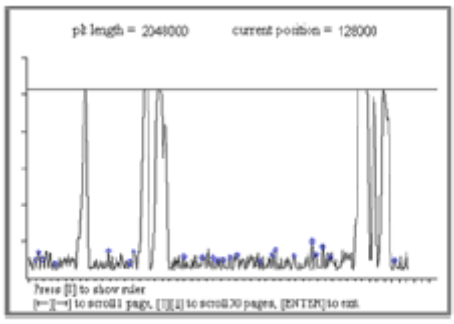


Figure 4-23 Severe interference in PLT channel and data length increases obviously (normal sample)

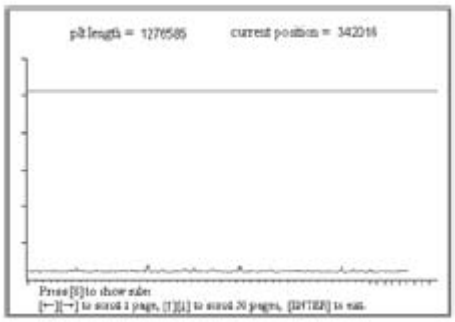


Figure 4-24 Interference occurs because gain of PLT channel is too large and data length increases (background)

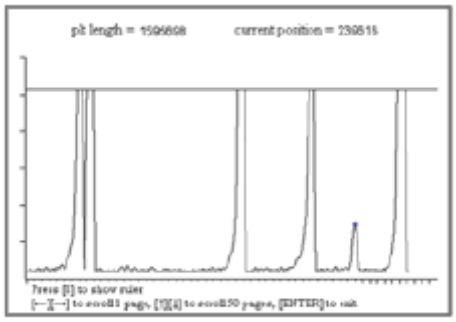


Figure 4-25 Interference occurs because gain of PLT channel is too large data length increases (normal sample)

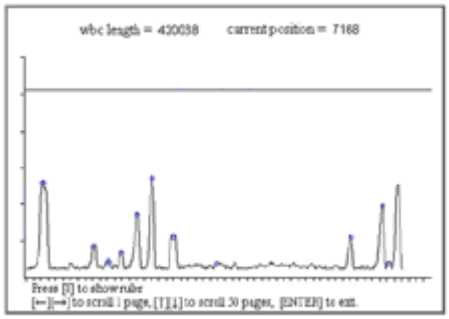


Figure 4-26 Slight interference in WBC channel and data length does not increase obviously (normal sample)

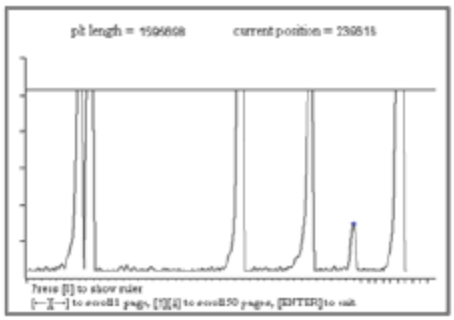


Figure 4-27 Slight interference in PLT channel and data length does not increase obviously (normal sample)

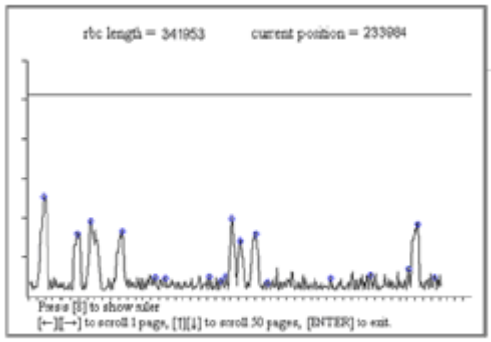


Figure 4-28 Slight interference in RBC channel and data length does not increase obviously (normal sample)

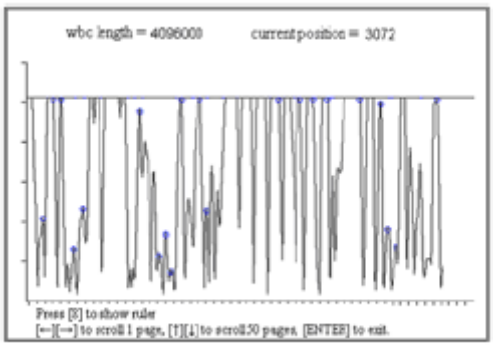


Figure 4-29 Inadequate or no hemolysis in WBC channel and data length increases

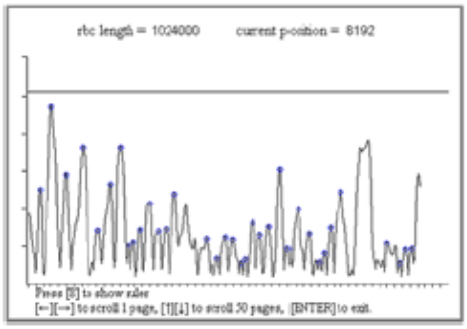


Figure 4-30 Too high sample concentration in the RBC channel (it normally does not appear)

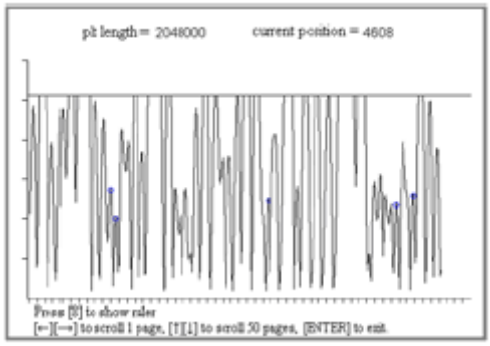


Figure 4-31 Too high concentration in the PLT channel (it normally does not appear)

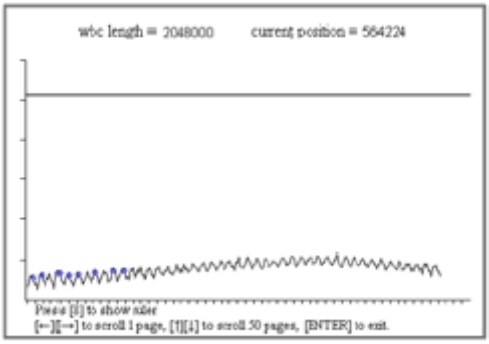


Figure 4-32 Interference in WBC channel caused by inverter. Feature: sine wave with cycle of 20～26us

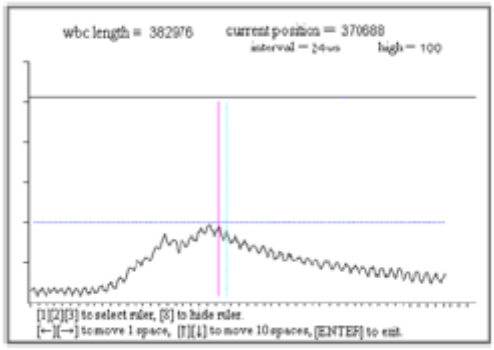


Figure 4-33 Measuring interference from inverter

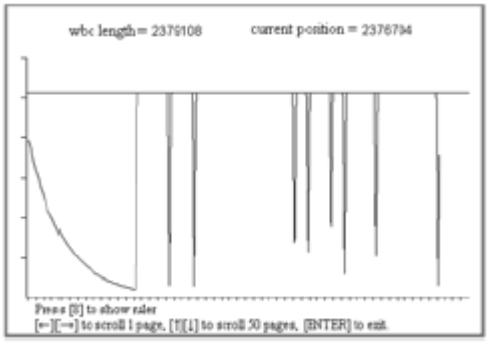


Figure 4-34 Insufficient liquid in WBC bath during count

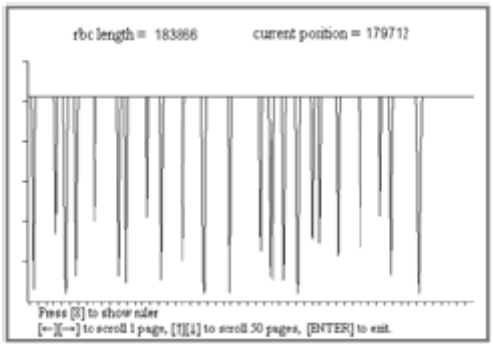


Figure 4-35 Insufficient liquid in RBC bath during count

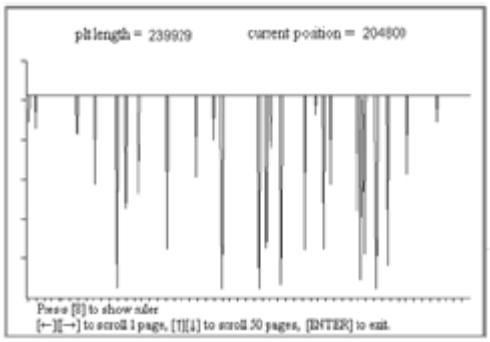


Figure 4-36 Insufficient liquid in RBC bath during PLT counting

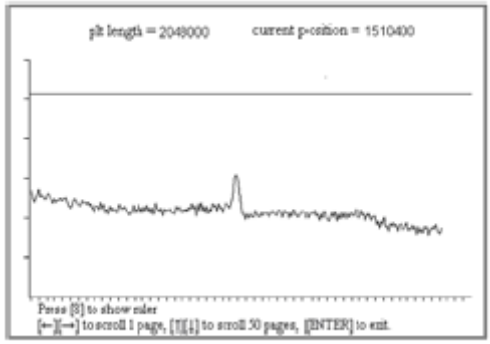


Figure 4-37 Interference in PLT channel from tubing. Feature: data length increases, the base line of signal is not stable.

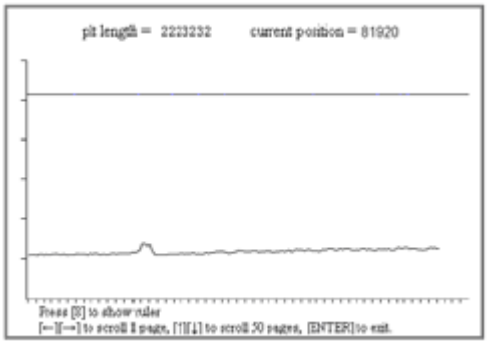


Figure 4-38 Interference in WBC channel from tubing. Feature: data length increases, the base line of signal is not stable.

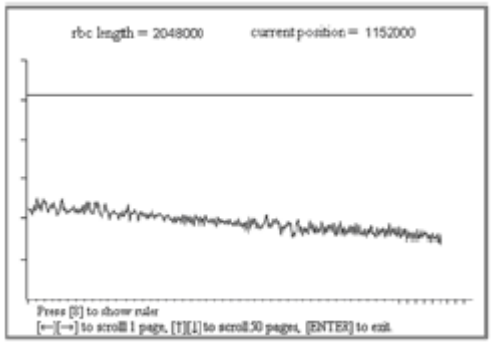


Figure 4-39 Interference in RBC channel from tubing. Feature: data length increases, the base line of signal is not stable.

Chapter5 Adjustment

This chapter deals with gain adjustment and hardware adjustment.

5.1 Gain Adjustment

5.1.1 Adjust the channel gains if you replace the below parts:

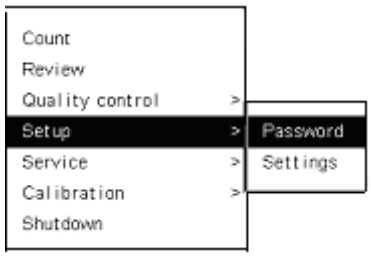
the bath (s)；
the aperture (s)；
the analog board；
the Disk-on-Module.

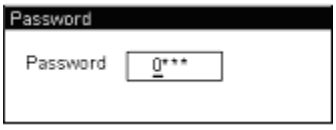
Method:

1. Using normal patient fresh blood or calibrator to check the gains.
2. Control the gains through the digital potential-meter.

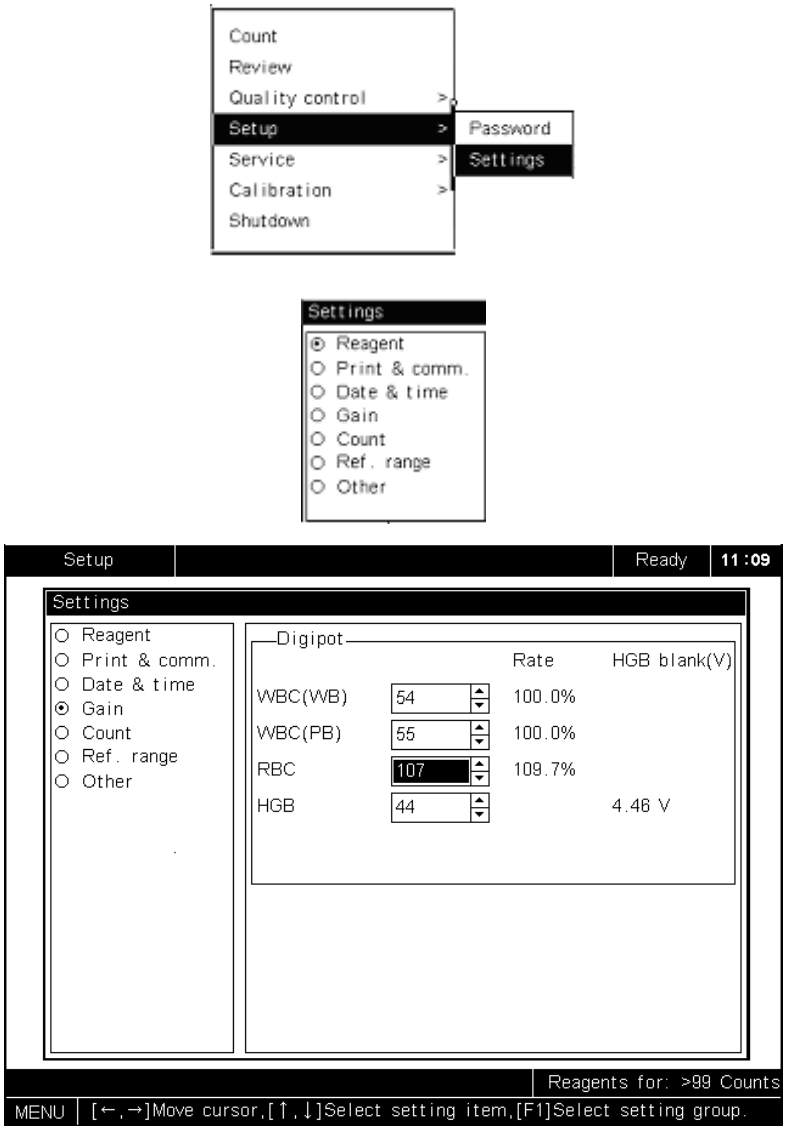
Replacement of the analog board will affect WBC（whole blood）, WBC（prediluted）, RBC, HGB, PLT results.
Replacement of the bath(s) will affect WBC（whole blood）, WBC（prediluted）, RBC, HGB, PLT
Replacement of the aperture(s) or gasket (s) will affect WBC（whole blood）, WBC（prediluted）, RBC,PLT

Enter the ***Password*** screen and enter the password – ***3210***.





Press [MENU] to enter the system menu, move the cursor to ***Setup*** → ***Gain*** and press [ENTER] to enter the ***Gain*** screen.



Displayed values：current gains
Range：adjustable range
Rate：changing factor compared to the old value.

WBC(whole blood)：gain of the WBC channel in the whole blood mode
WBC（prediluted)：gain of the WBC channel in the prediluted mode
RBC：gain of the RBC channel
HGB：gain of the HGB gain
PLT：gain of the PLT channel.

Chapter6 Maintenance

Regular cleaning and maintenance are demanded to guarantee this analyzer operating properly. This chapter introduces how to take care of this analyzer and check the system status.

Liquid overflow or leak during the operation of this analyzer will degrade the accuracy of the analysis results. Once it occurs, immediately wipe off the spills. If it occurs inside this analyzer, be sure to shut down the power immediately and call Mindray Customer Services Department or the distributor. Otherwise, the service life of this analyzer may be shortened.

6.1 Regular Maintenance

To keep this analyzer in a good shape, regular maintenance is demanded.

6.1.1 Special Notes

The parts in contact with blood are potentially infectious. Be sure to wear standard laboratory attire (including rubber gloves) when maintaining or operating this analyzer and wash your hands with detergent when you are done.

- Be sure to keep you hair, clothes, cuff or hands away from the moving parts of this analyzer.
- Be sure to use specified tools or parts to maintain this analyzer and be sure to clean the used tools as instructed by their instruction manual when you are done.
- Be sure to use soft and clean cloth, or neutral detergent-soaked cloth (twisted dry), or soft cloth washed by ethanol to clean the surface of this analyzer.
- Be sure to pay attention to the marks or symbols on this analyzer. Be sure not to touch the power plug at the back of this analyzer with wet hands or wet rags.
- Be sure not use organic solvent or acid/alkaline detergent to wash the surface of this analyzer. Otherwise, the surface may fade or become corrupted.
- Be sure to avoid direct contact with the reagents that will hurt your eyes, skin and diaphragm. In case you spill the reagents on you skin, be sure to wash them off with much water. In case you spill the reagents into your eyes, be sure to immediately wash your eyes with much water and go see a doctor for further treatment.

6.1.2 Recommended Regular Maintenance

Table 6-1 Recommended Regular Maintenance

Maintenance Period	Content of Maintenance
Everyday	If you are to use this analyzer 24 hours a day, be sure to perform the ***E-Z cleanser cleaning*** procedure everyday.
	Run the QC program everyday. S
Every three days	If you are to use this analyzer 24 hours a day, be sure to perform the ***Probe cleanser cleaning*** procedure every three days.
Every Week	If you shut down your analyzer every day and follow the specified shutdown procedure to do that, you need to perform the ***Probe cleanser cleaning*** procedure every week.
Every Month	You should use the supplied probe localizer to calibrate the position of the probe to that of the wipe block. The analysis result is sensitive to their alignment.
As needed	When you think the bath might be dirty, perform the ***Clean the bath*** procedure.
	When the analyzed samples add up to 200, the system will remind you to perform the ***Probe cleanser cleaning*** procedure.
	When the analyzed samples add up to 4,000, the system will remind you to perform the ***Clean wipe block*** procedure.
	When this analyzer is not to be used for two weeks, be sure to perform the ***Prepare to ship*** procedure to empty and wash the fluidic system.
	To obtain reliable analysis results, this analyzer needs to work in a normal status. Be sure to run the ***Self-test*** items regularly to check the status of this analyzer.
	When this analyzer gives alarms for clogging, you can perform the ***Flush aperture*** or ***Zap aperture*** procedure, or press [F2] at the ***Count*** screen to unclog the system.
	If you see other error messages, see **Chapter 7 Troubleshooting**, for solutions.

6.2 System Maintenance

Press [MENU] to enter the system menu and press the appropriate arrow keys ([↑][↓][←][→])to move the cursor to ***Service*** → ***Maintenance***, as Figure 6-1 shows.

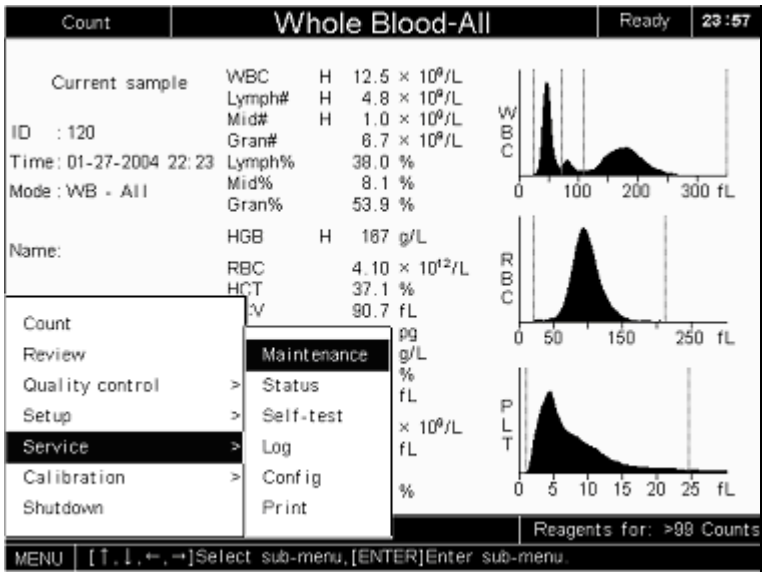


Figure 6-1 Entering maintenance screen

Press [ENTER] to enter the ***Maintenance*** screen, as Figure 6-2 shows.

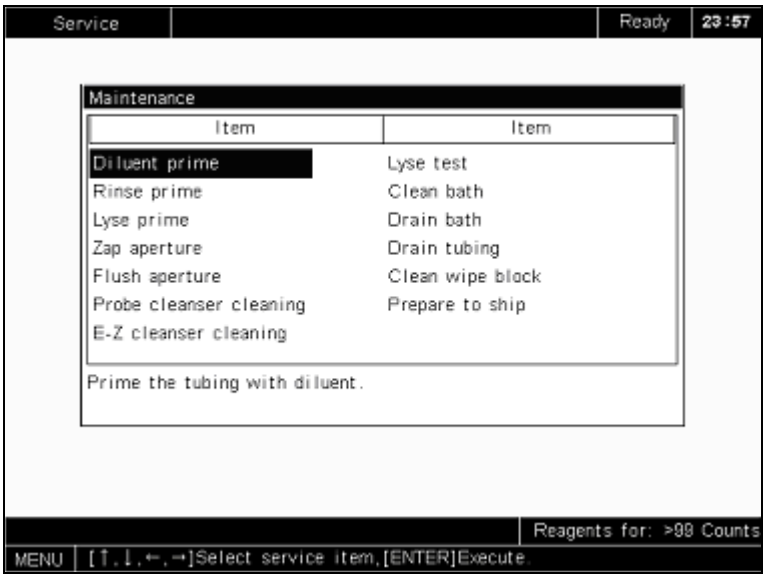


Figure 6-2 Maintenance screen

If you want to exit this screen, press [MENU] to enter the system menu and access the desired screen from there.

6.2.1 Diluent Prime

Biohazard

Wear standard laboratory attire (including rubber gloves) and follow safe laboratory procedures when handling any material in the laboratory.

You should perform the ***Diluent prime*** procedure to prime the diluent tubing with diluent when

- there are bubbles in the tubing; or
- the diluent in the tubing is contaminated; or
- the old diluent ran out and a new container of diluent is installed.

Follow the steps given below to do so

- At the ***Maintenance*** screen, press the appropriate arrow keys ([↑][↓][←][→]) to move the cursor to ***Diluent Prime***.
- Press [ENTER] to prime the tubing with diluent and the priming progress will be displayed at the bottom of the screen, as Figure 6-3 shows.
- When the priming is done, the screen will return to the initial state.

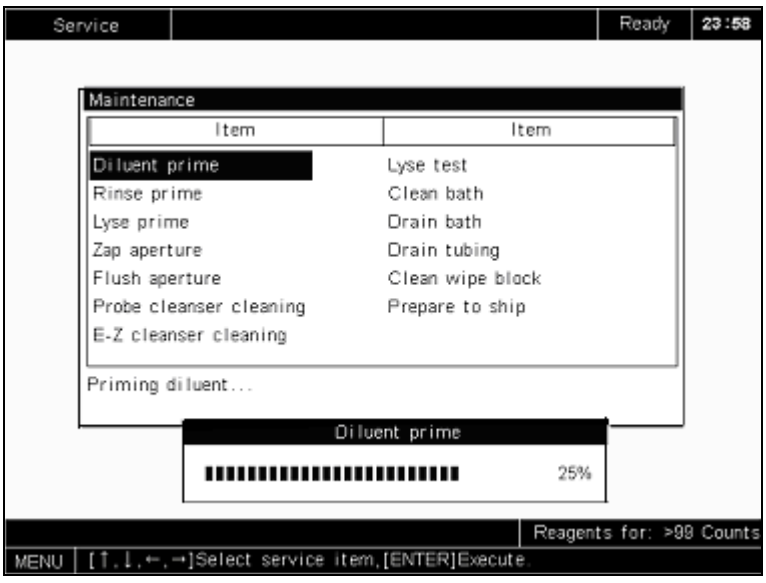


Figure 6-3 Diluent priming screen

6.2.2 Rinse Prime

Biohazard

Wear standard laboratory attire (including rubber gloves) and follow safe laboratory procedures when handling any material in the laboratory.

You should perform the ***Rinse prime*** procedure to prime the rinse tubing with rinse when

- there are bubbles in the tubing; or
- the rinse in the tubing is contaminated; or
- the old rise ran out and a new container of rinse is installed.

Follow the steps given below to do so:

- At the ***Maintenance*** screen, press the appropriate arrow keys ([↑][↓][←][→]) to move the cursor to ***Rinse prime***.
- Press [ENTER] to prime the tubing with rinse and the priming progress will be displayed at the bottom of the screen, as Figure 6-4 shows.
- When the priming is done, the screen will return to the initial state.

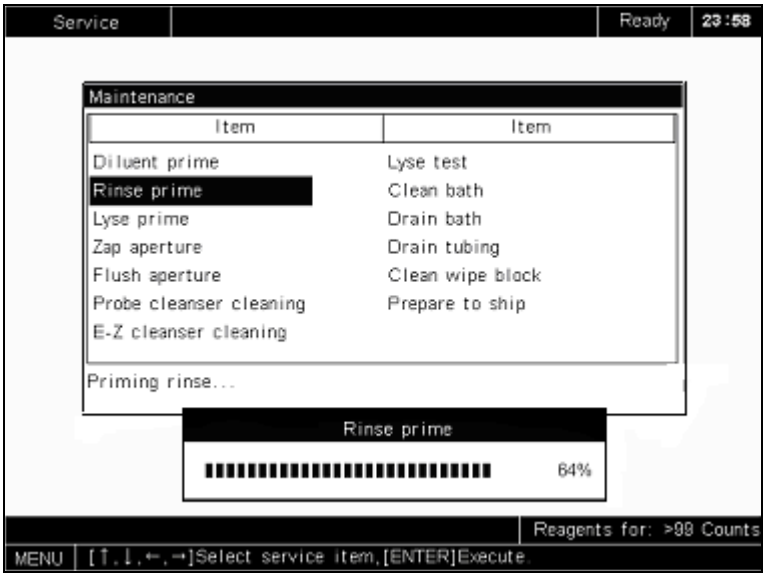


Figure 6-4 Rinse Priming screen

6.2.3 Lyse Prime

Biohazard

Wear standard laboratory attire (including rubber gloves) and follow safe laboratory procedures when handling any material in the laboratory.

You should perform the ***Lyse prime*** procedure to prime the lyse tubing with lyse when

- there are bubbles in the tubing; or
- the lyse in the tubing is contaminated; or
- the old lyse ran out and a new container of lyse is installed.

Follow the steps given below to do so:

- At the ***Maintenance*** screen, press the appropriate arrow keys ([↑][↓][←][→]) to move the cursor to ***Lyse prime.***
- Press [ENTER] to prime the tubing with lyse and the priming progress will be displayed at the bottom of the screen, as Figure 6-5 shows.
- When the priming is done, the screen will return to the initial state.

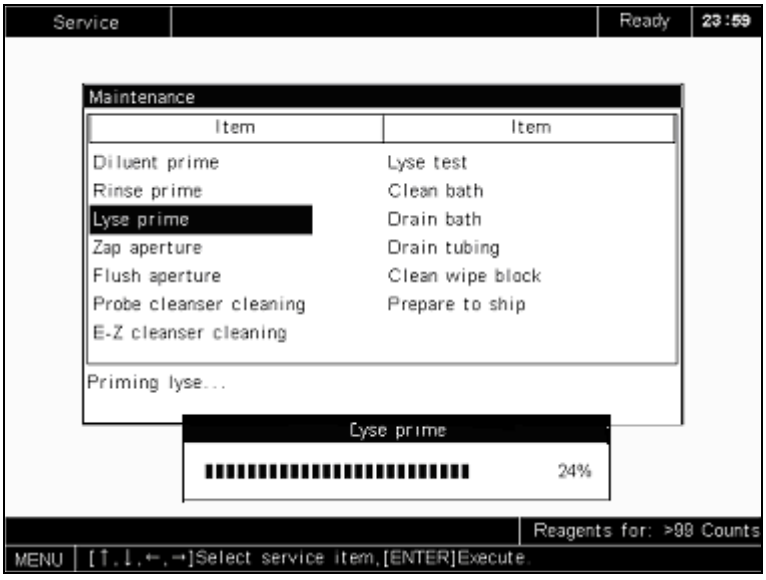


Figure 6-5 Lyse priming screen

6.2.4 Zap Aperture

You can perform the ***Zap aperture*** procedure to unclog or prevent clogging. Follow the steps given below to do so:

- At the ***Maintenance*** screen, press the appropriate arrow keys ([↑][↓][←][→])

to move the cursor to ***Zap aperture.***

- Press [ENTER] to zap the aperture and the zapping progress will be displayed at the bottom of the screen, as Figure 6-6 shows.
- When the zapping is done, the screen will return to the initial state.

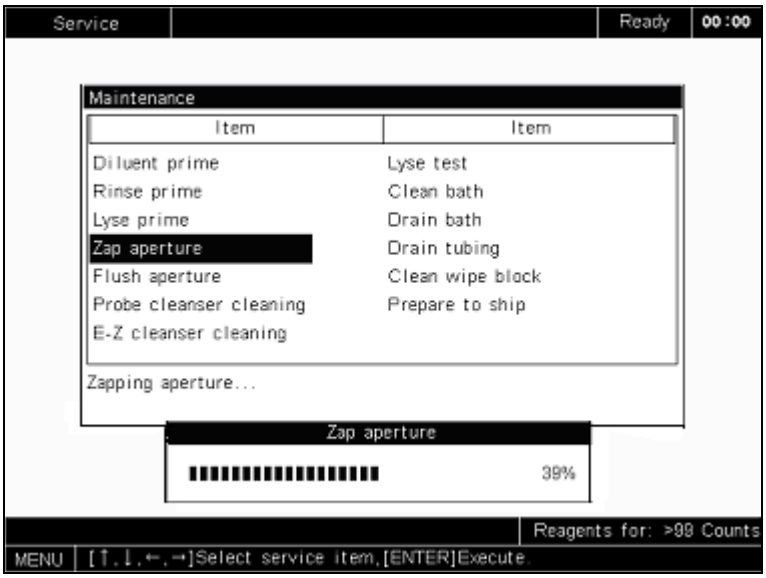


Figure 6-6 Zapping aperture

6.2.5 Flush Aperture

You can perform the ***Flush aperture*** procedure to assist zapping the aperture.

Follow the steps given below to perform the procedure：

- At the ***Maintenance*** screen, press the appropriate arrow keys ([↑][↓][←][→]) to move the cursor to ***Flush aperture***.
- Press [ENTER] to flush the aperture and the flushing progress will be displayed at the bottom of the screen, as Figure 6-7 shows.
- When the flushing is done, the screen will return to the initial state.

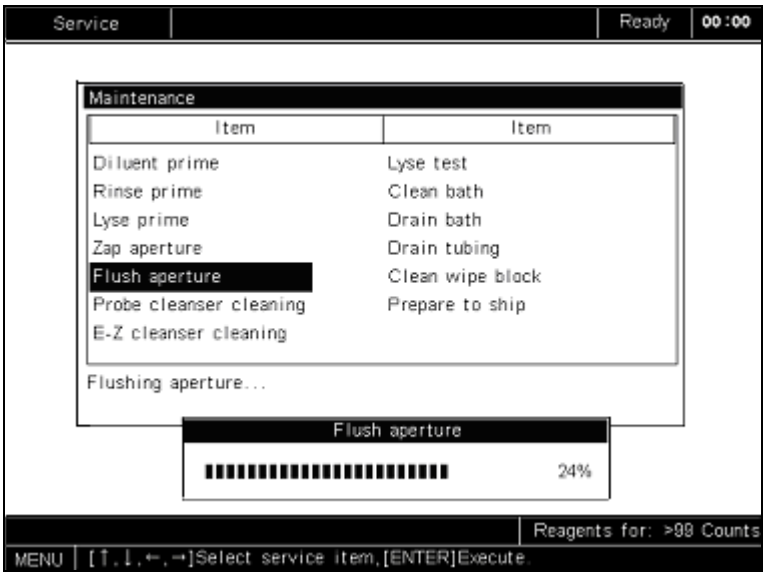


Figure 6-7 Flushing aperture

6.2.6 Probe Cleanser Cleaning

Biohazard

Wear standard laboratory attire (including rubber gloves) and follow safe laboratory procedures when handling any material in the laboratory.

You can soak the bath and tubing with the probe cleanser, an alkaline detergent, by performing the **Probe cleanser cleaning** procedure. If your analyzer is to run 24 hours a day, you should perform this procedure every 3 days. If you follow the shutdown procedure to turn off your analyzer everyday, you should perform this procedure every week.

Follow the steps given below to do so:

- At the ***Maintenance*** screen, press the appropriate arrow keys ([↑][↓][←][→]) to move the cursor to ***Probe cleanser cleaning***.
- Present the cleanser to the probe and press [ENTER] to aspirate the cleanser. Remove the cleanser after the probe has risen up. This analyzer will automatically soak the bath and tubing with the aspirated cleanser.
- The soaking process will last about 5 minutes and you may press [ENTER] to stop the process any time. Note that a shortened soaking process may not be as effective as a complete one.

- When the soaking is done, press [ENTER] to flush the bath and tubing, after which screen will return to the initial state.

To make sure this analyzer functions normally, every time the accumulated analyzed samples reach 200, a dialog box will pop up to remind you to perform the ***Probe cleanser cleaning*** procedure, as Figure 6-8 shows. If you want to do so, move the cursor to ***Yes*** and press [ENTER]; otherwise, move the cursor to ***No*** and press [ENTER].

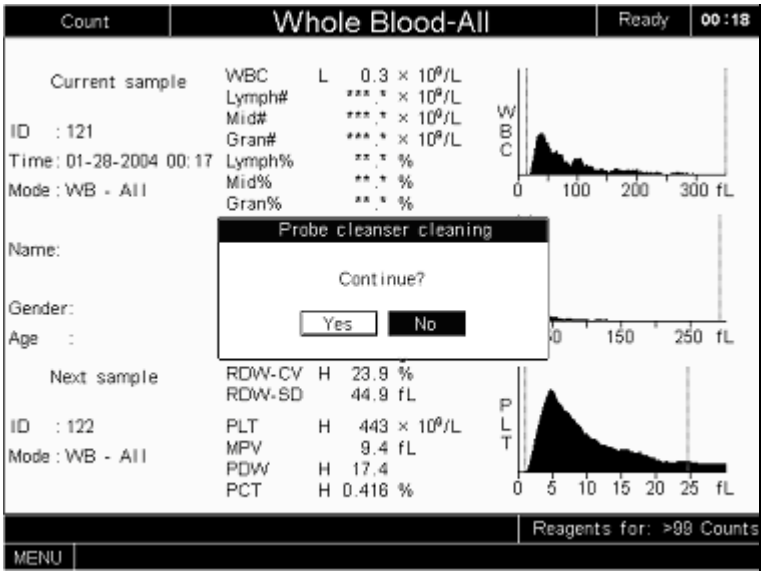


Figure 6-8 Recommending probe cleanser cleaning

6.2.7 E-Z Cleanser Cleaning

Biohazard

Wear standard laboratory attire (including rubber gloves) and follow safe laboratory procedures when handling any material in the laboratory.

You can use the E-Z cleanser, an enzyme based, isotonic cleaning solution and wetting agent, to clean the tubing and bath by performing the ***E-Z cleanser cleaning*** procedure.

Follow the steps given below to perform the procedure:

- At the ***Maintenance*** screen, press the appropriate arrow keys ([↑][↓][←][→]) to move the cursor to ***E-Z cleanser cleaning***.
- Present the cleanser to the probe and press [ENTER] to aspirate the cleanser. Remove the cleanser after the probe has risen up. This analyzer will automatically soak the bath and tubing with the aspirated cleanser.

- The soaking process will last about 10 minutes and you may press [ENTER] to stop the process any time. Note that a shortened soaking process may not be as effective as a complete one.
- When the soaking is done, press [ENTER] to flush the bath and tubing, after which the screen will return to the initial state.

If you analyzer has been running continuously for 24 hours, a dialog box will pop up to remind you to perform the ***Probe cleanser cleaning*** procedure. If you want to do so, move the cursor to ***Yes*** and press [ENTER]. Otherwise, move the cursor to ***No*** and press [ENTER].

6.2.8 Lyse Test

Biohazard

Wear standard laboratory attire (including rubber gloves) and follow safe laboratory procedures when handling any material in the laboratory.

In case of any abnormal WBC counts or histograms, you can perform the **Lyse test** procedure to check whether the lyse can be dispensed properly.

Follow the steps given below to do so:

- Unscrew and remove the retaining screws with hands or screwdrivers (pointed by the arrows shown in Figure 6-9) on the right plate.

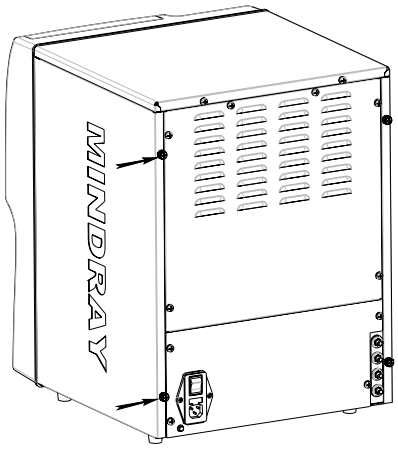


Figure6-9 Removing the two screws

- Follow the arrow shown in Figure 6-10 to push and remove the right plate.

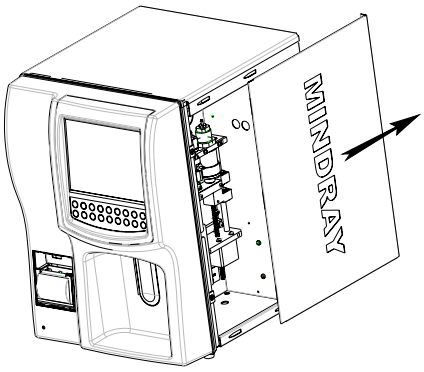


Figure 6-10 Removing right plate

- Remove the screws fixing the shielding box of the bath, as Figure 6-11 shows.

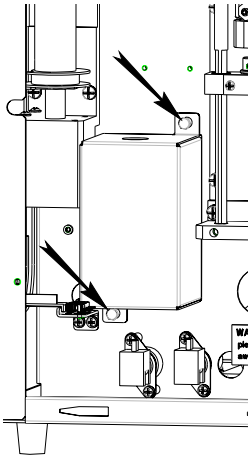


Figure 6-11 Shielding box

- Remove the shielding box to expose the bath, as Figure 6-12 shows.

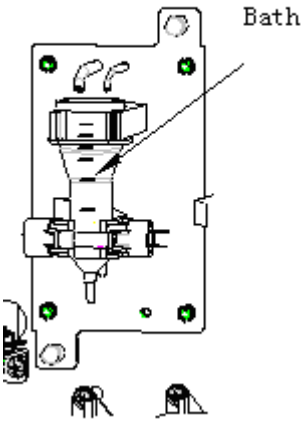


Figure 6-12 Bath

- At the ***Maintenance*** screen, press the appropriate arrow keys ([↑][↓][←][→]) to move the cursor to ***Lyse test***
- Press [ENTER] and this analyzer will automatically drain the bath and then dispense 2ml lyse to the bath.
- Check the scale to see whether the lyse has reached the expected line (the second from bottom). In case the dispensed lyse has failed to reach this line for several consecutive times, check whether the lyse has run out or the lyse tubing is not properly connected to this analyzer. If the lyse is still enough and the tubing is well connected to the analyzer, contact the Mindray Customer Service Department for repair.
- Press [ENTER] to flush the bath and finish the test. The screen will return to the initial state.

6.2.9 Clean Bath

When you keep finding abnormal results from the background check, follow the steps given below to perform the ***Clean Bath*** procedure:

- At the ***Maintenance*** screen, press the appropriate arrow keys ([↑][↓][←][→]) to move the cursor to ***Clean bath***.
- Press [ENTER] to start the procedure.
- When the cleaning is done, the screen returns to the initial state.

6.2.10 Drain Bath

The ***Drain Bath*** procedure checks whether the analyzer can drain the bath within the given time. You can perform this procedure when you find three or more of the HGB, WBC, RBC and PLT results are abnormal.

- Follow the first 4 steps of performing the ***Lyse Test*** procedure to expose the bath.

- At the ***Maintenance*** screen, press the appropriate arrow keys ([↑][↓][←][→]) to move the cursor to ***Drain bath***.
- Press [ENTER] to start the procedure and the screen will display the progress bar..
- When the bath is drained, the screen displays ***Drain bath***, as Figure 6-13 shows..
- Check the bath and its lower hose for residual liquid. If there is, turn off the analyzer and call the Mindray Customer Service Department or the distributor for repair; if not, press [ENTER] and the analyzer will prime the bath with diluent.
- When the priming is done, the screen will return to the initial state and you should try to find other reasons the contribute to the abnormal results.

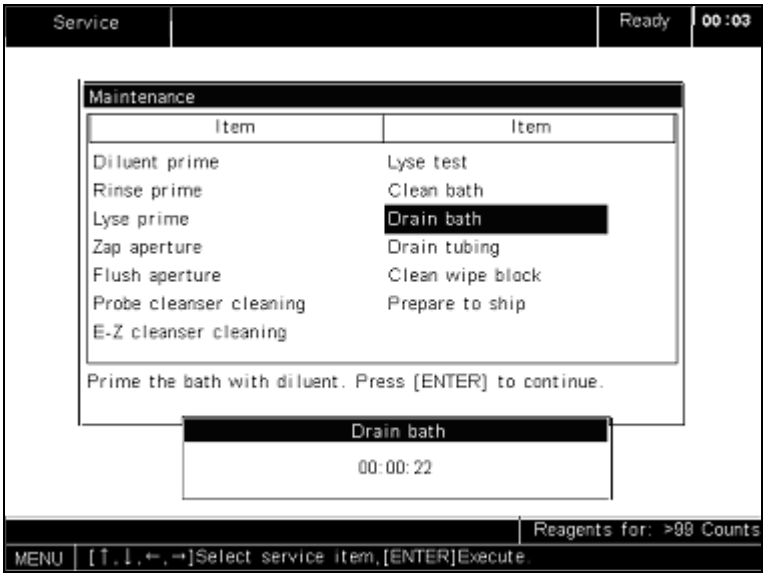


Figure6-13 Drain Bath

6.2.11 **Draining Tubing**

If this analyzer is not to be used for a long time or it is to be maintained, be sure to perform the ***Drain tubing*** procedure.

Follow the steps given below to do so：

- At the ***Maintenance*** screen, press the appropriate arrow keys ([↑][↓][←][→])to move the cursor to ***Drain tubing***.
- Press [ENTER] and follow the displayed instructions to remove all the tubes, except for the one for the waste, from this analyzer.
- Press [ENTER] to start the draining procedure.
- When the draining is done, the screen will display ***Turn off this analyzer*** and you should turn off this analyzer as instructed.

6.2.12 Cleaning Probe Wipe Block

After being used for a long time, the bottom of the probe wipe block may be contaminated by blood and the inside of the block may also be contaminated by the dirt sucked in. So you need to clean the wipe block regularly.

Follow the steps given below to do so:

- At the ***Maintenance*** screen, press the appropriate arrow keys ([↑][↓][←][→])to move the cursor to ***Clean wipe block***.
- Present the probe cleanser to the sample probe and press [ENTER] to aspirate the cleanser. Remove the cleanser after the probe has risen up.
- Unscrew and remove the retaining screws with hands or screwdrivers (pointed by the arrows shown in Figure 6-9) on the right plate of this analyzer.
- Follow the arrow shown in Figure 6-10 to push and remove the right plate.
- Follow the instructions displayed on the screen to place an empty cup below the sample probe.
- Press [ENTER] to soak the wipe block with the aspirated cleanser. The soaking progress will be displayed on the screen, as Figure 6-14.

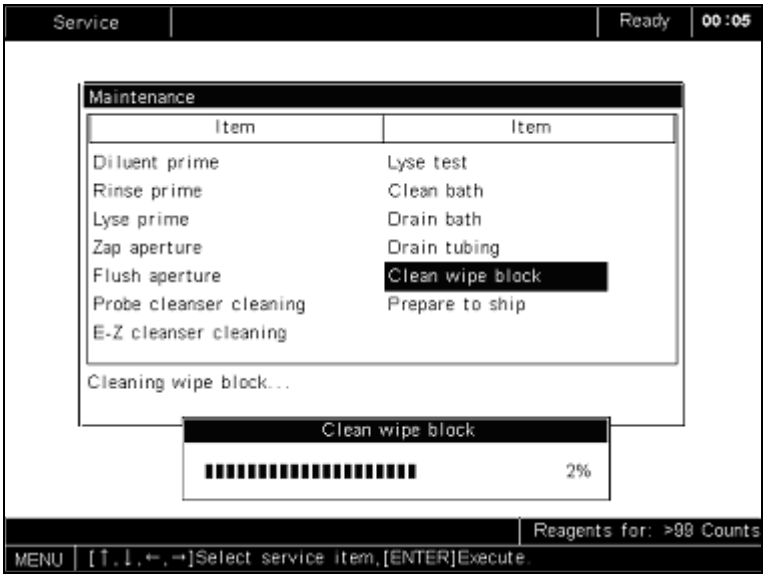


Figure 6-14 Cleaning wipe block

- When the soaking is done, wipe the bottom of the wipe block with a probe cleanser-dipped cloth that does not leave debris.
- Press [ENTER] to flush the block and the inner surface of the probe.
- After the flushing is done, the screen returns to the initial state.
  When the accumulated analyzed samples reach 4,000, a dialog box will pop up to remind to clean the wipe block. You may move the cursor to Yes and press [ENTER] to start the cleaning, or to No and press [ENTER] to ignore the message.

6.2.13 **Preparing to Ship**

If this analyzer is not to be used for over two weeks, or is to be shipped, perform the ***Prepare to ship*** procedure to flush and drain it.

Follow the steps given below to do so:

- Remove the diluent, rinse and lyse tubing from their containers.
- At the ***Maintenance*** screen, press the appropriate arrow keys ([↑][↓][←][→]) to move the cursor to ***Prepare to ship***.
- Press [ENTER] and a dialog box will pop up to ask you to confirm this operation, as Figure 6-15 shows

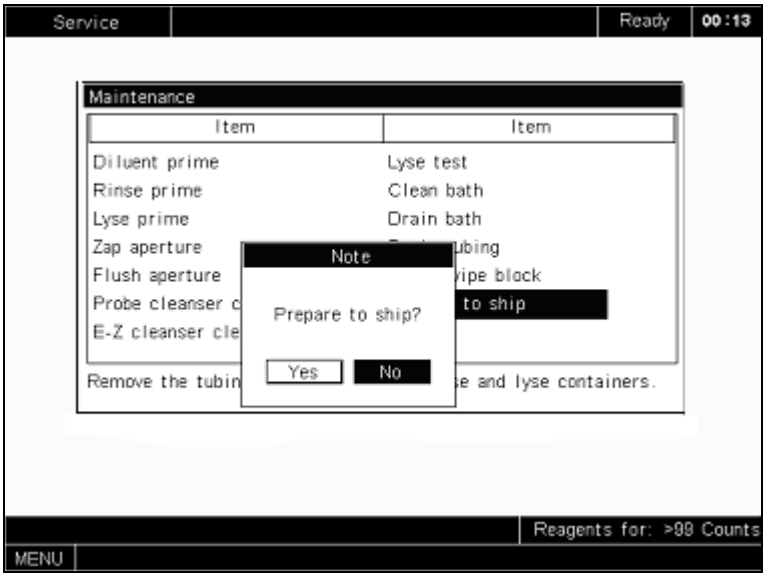


Figure 6-15 A dialog box of Prepare to ship

- Move the cursor to ***Yes*** and press [ENTER] if you want to proceed with this procedure, or to ***No*** and press [ENTER] if you wan to abort this operation. If there is any error present, the system will not perform this procedure. Follow the instructions displayed on the screen to remove the error before trying to perform the procedure again.
- After draining the tubing, follow the instructions displayed on the screen to put the rinse, diluent and lyse tubing into distilled water and press [ENTER] to flush this analyzer with the distilled water.
- When the washing is over, follow the instructions displayed on the screen to remove the rinse, diluent and lyse tubing from the distilled water and press [ENTER] to drain the tubing again.
- Turn off the analyzer when the screen displays Turn off the analyzer.
- Wipe this analyzer dry and wrap it up for storage.

6.3 System Status

The items displayed in the ***Status*** screen reflect how the system is functioning and contribute significantly to diagnosing system errors. You may follow the instructions given below to check those items.

Press [MENU] to enter the system menu and press the appropriate arrow keys to move the cursor to ***Service*** → ***Status***, as Figure 6-16 shows.

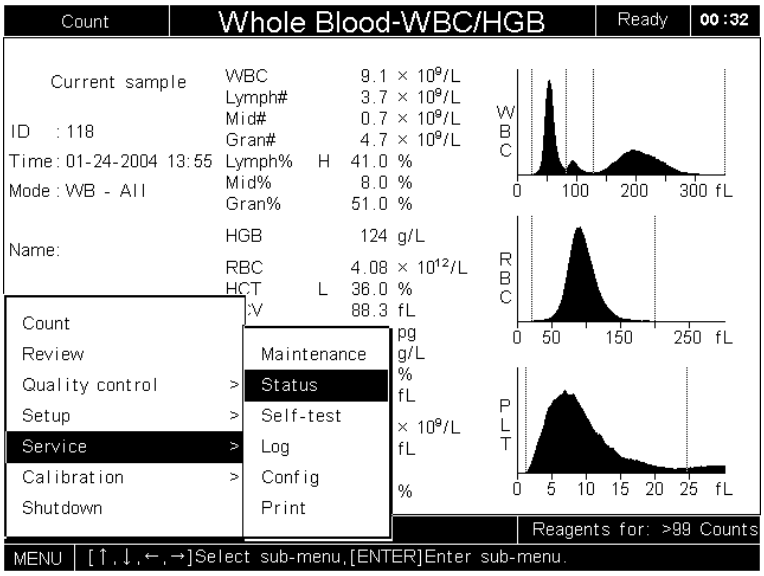


Figure 6-16 Entering status screen

Press [ENTER] to enter the ***Status*** screen, as Figure 6-17 shows.

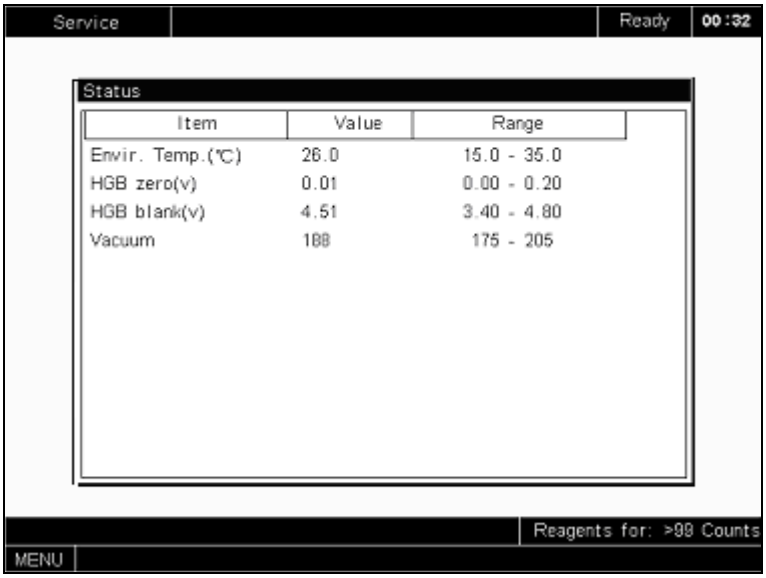


Figure6-17 Status screen

Note that you can only view the displayed status items without changing them. If any of the displayed item exceeds the given range, see **Chapter 7 Troubleshooting** for solutions.

6.4 System Self-Test

The system self-test is a major way to locate system errors. Follow the instructions given below to view and check the available self-test items.

Press [MENU] to enter the system menu and press the appropriate arrow keys([↑][↓][←][→])to move the cursor to ***Service*** → ***Self-test***, as Figure 6-18 shows.

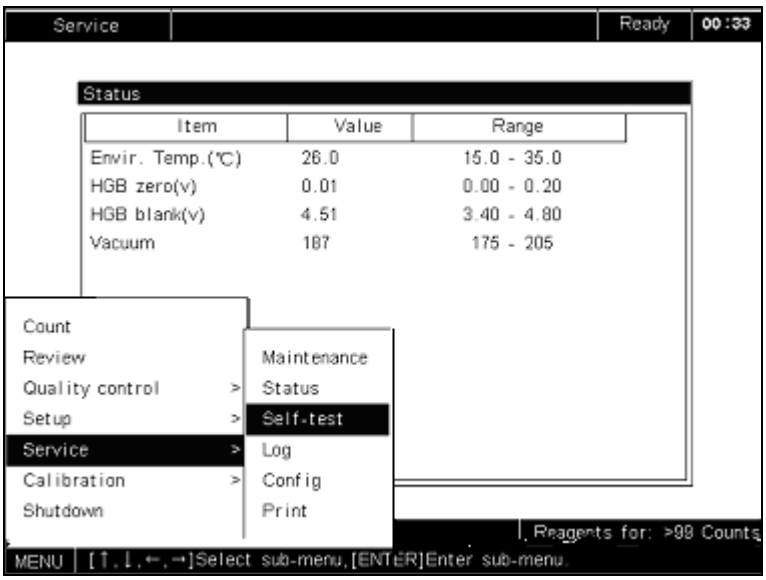


Figure 6-18 Entering self-test screen

Press [ENTER] to enter the ***Self-test*** screen, as Figure 6-19 shows. If you want acquire help information, press [HELP].

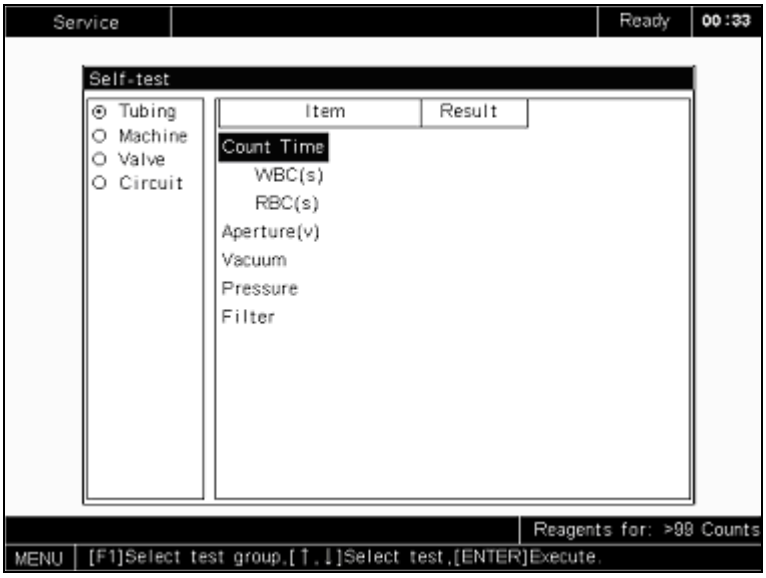


Figure 6-19 Self-test screen

The available self-test items are divided into four groups, the ***Tubing***, ***Machine***, ***Valve*** and ***Circuit***, as shown on the left of the screen. You can switch among the groups by pressing [F1] and once a group is selected, the included test items, together with their test results (if available), will be displayed on the right of the screen. You may press [PRINT] to print out the displayed results. Follow the instructions given below to conduct every test and if you want to acquire help information, press [HELP].

6.4.1 Testing Tubing

At the self-test screen, press [F1] to select the ***Tubing*** group, as Figure 6-19 shows. The following test items will be displayed on the right of the screen:

Count Time

It measures the duration of a WBC and RBC count, namely how many seconds it takes for the aspirated fluid flows from the first sensor to the second.

Aperture(v)

It measures the voltage (v) over the aperture.

Vacuum

It checks whether the vacuum system functions normally.

Pressure

It checks whether the system flushes the aperture at a normal pressure.

Filter

It checks whether the filter functions normally.

6.4.2 Testing Motors and Recorder/Printer

At the ***Self-test*** screen, press [F1] to select the ***Machine*** group, as Figure 6-20 shows. The following test items will be displayed on the right of the screen. Press [↑] or [↓] to select the desired item and press [ENTER] to conduct the test.

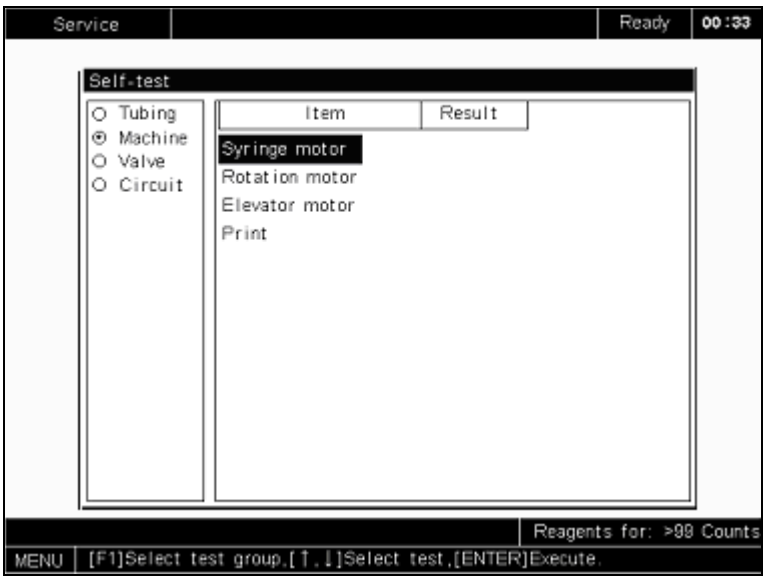


Figure 6-20 Testing mechanic parts

1. Syringe motor

   The syringe motor controls the aspiration volume. This test checks whether the motor functions normally.

2. Rotation motor

   The rotation motor rotates the sample probe inside the analyzer. This test checks whether the motor functions normally.

3. Elevator motor

   The elevator motor controls elevation of the sample probe. This test checks whether the motor functions normally.

4. Print

   This test checks whether the recorder or printer functions normally. If normal, when you press [ENTER], the recorder or printer will print out test page; if abnormal, the screen will display the corresponding error message and you can

see **Chapter 7 Troubleshooting** for solutions.

6.4.3 Testing Valves

Malfunctioning valves will lead to tubing malfunctions. Therefore, testing the valves is a major way to remove fluidic errors.

At the ***Self-test*** screen, press [F1] to select the ***Valve*** group, as Figure 6-21 shows. The following test items will be displayed on the right of the screen. Press the appropriate arrow keys ([↑][↓][←][→])to select the valve you want to check and press [ENTER] to test it. If the valve goes through the Off-On-Off sequence without making abnormal sound, it passes the test. Otherwise, something may be wrong with the valve.

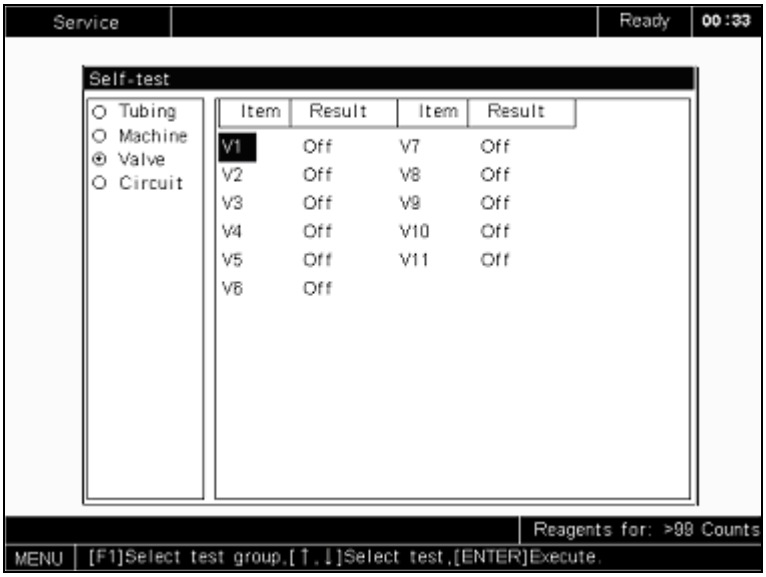


Figure 6-21 Testing valves

6.4.4 Testing Circuits

At the ***Self-test*** screen, press [F1] to select the ***Circuit*** group, as Figure 6-22 shows. You can test the **A/D interrupt** at this screen by pressing [ENTER] to see whether the WBC, RBC and PLT signals can be properly converted into digital signals.

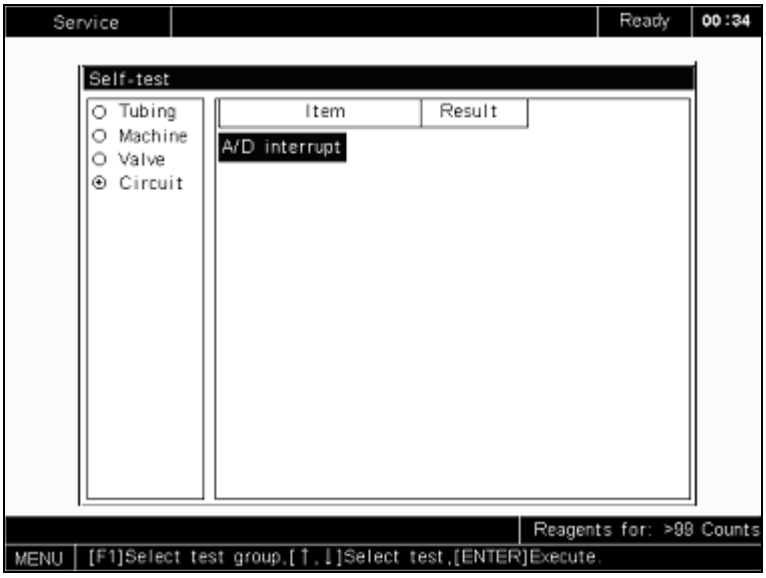


Figure 6-22 Testing A/D converter

6.5 Log

The log records all the major events taking place during the running of this analyzer. It helps the service engineers diagnose system errors.

Press [MENU] to enter the system menu and press the appropriate arrow keys ([↑][↓][←][→]) to move the cursor to ***Service→Log***, as Figure 6-23 shows.

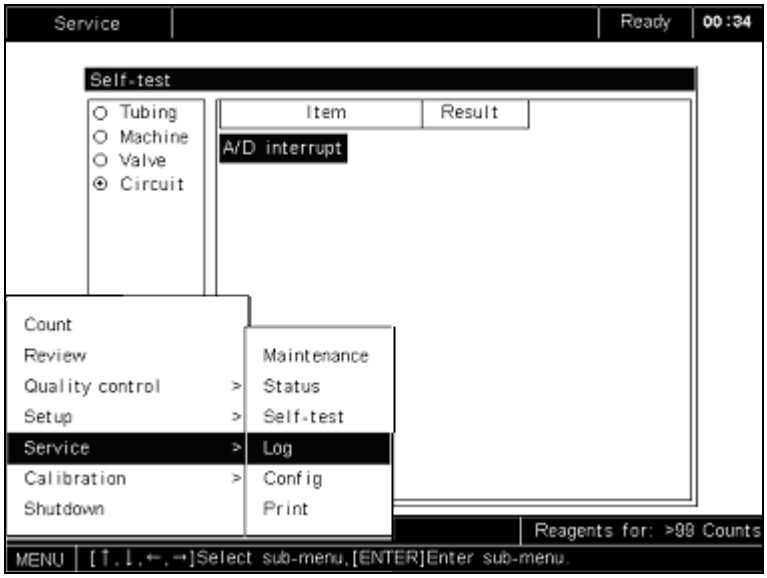


Figure 6-23 Entering log

Press [ENTER] to enter the ***Log*** screen, as Figure 6-24 shows.

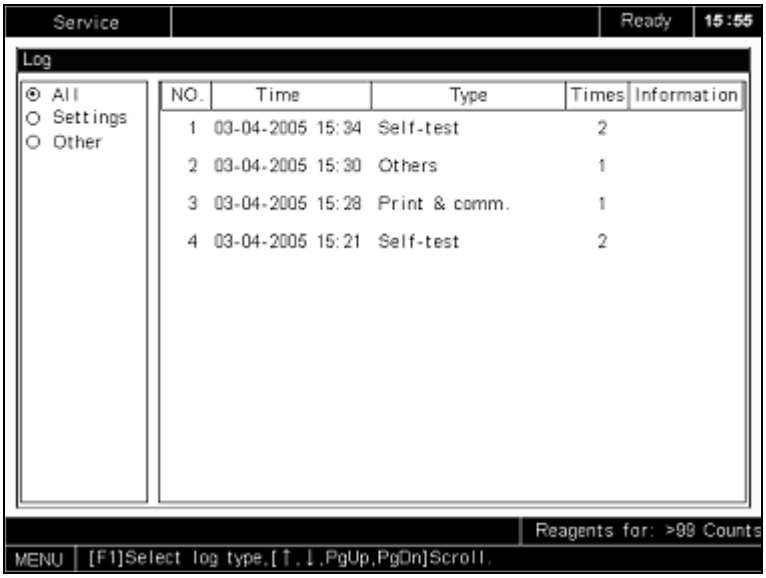


Figure 6-24 Log screen

The recorded events are divided into three groups, ***All, Settings*** and ***Other*** (including setting discriminators, system self-test and updating system software), which are all listed on the left of the screen. All the recorded events are listed on the right of the screen by default. You can press [F1] to select the interested group and the right of the screen will display the events of the selected group only. Every screen displays 10 events. You can press [↑] or [↓] to check the events one by one or press [PgUp] or [PgDn] to check the events on the previous or next screen. If you want to print out the displayed events, press [PRINT]. If you want to acquire help information, press [HELP].

For every recorded event, the ***NO.*** column displays the sequences of the recorded events; the ***Time*** column displays the time when this event occurred; the ***Type*** column displays the event type (the error events are also marked the corresponding error codes that are explained in **Chapter 7.1**); the ***Times*** column displays how many times (1～255) this event occurred and if it occurred more than 255 times, the excessive events will be recorded from 1 to another log file; the ***Information*** column displays extra information regarding the event.

This analyzer can save maximum 1000 log files and once the maximum number has been reached, the newest log will automatically cover the oldest one.

6.6 System Configuration

To view the system configuration, press [MENU] to enter the system menu, and then press the appropriate arrow keys to move the cursor to ***Service→Config*.**

Press [ENTER] to enter the ***Config*** screen, as Figure 6-25 shows, where you can only view the system configuration without changing it.

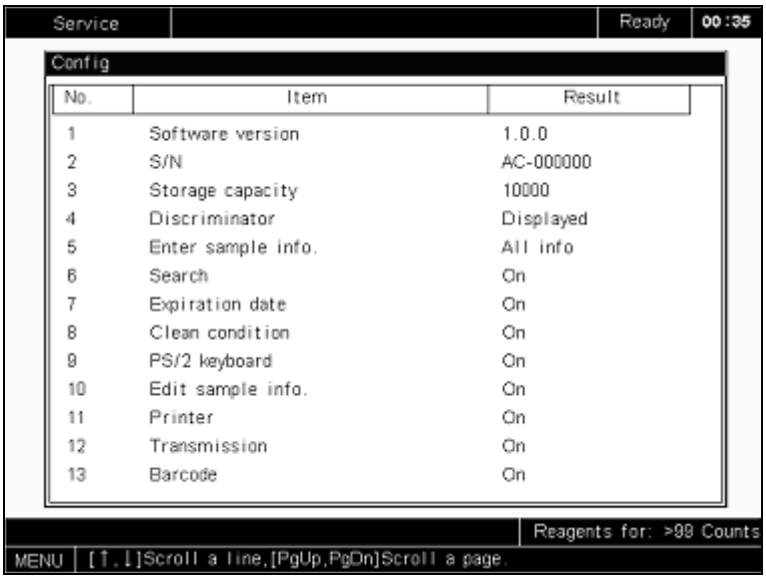


Figure 6-25 Configuration

Every screen displays 13 items and you can press [↑] or [↓] to select the item you want to see, or press[PgUp] or [PgDn] to go to the previous or next screen. If you want to print out the configuration, press [PRINT]. If you want to acquire help, press [HELP].

6.7 Printing Management

Press the [MENU] to enter the system menu and press the appropriate arrow keys ([↑][↓][←][→])to move the cursor to ***Service→Print***, as Figure 6-26 shows.

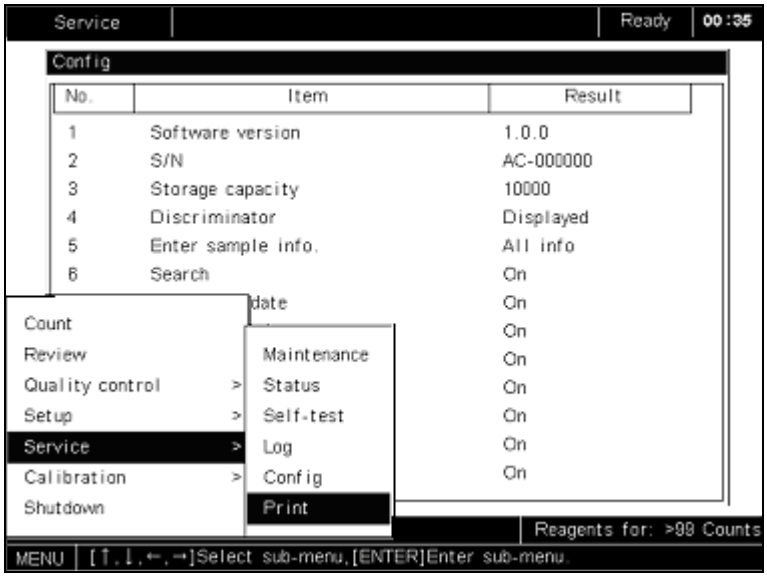


Figure 6-26 Entering print screen

Press [ENTER] to enter the ***Print*** screen, as Figure 6-27 shows. The printing tasks are queued in this screen, where you can view the all tasks and delete those waiting to be processed. Once something goes wrong with the printing device, the task being processed will be deleted and the queued tasks will keep waiting. Once the system finds the error has been removed, it will resume printing and process the tasks from the first one. Note that you cannot change the sequence of the queued tasks.

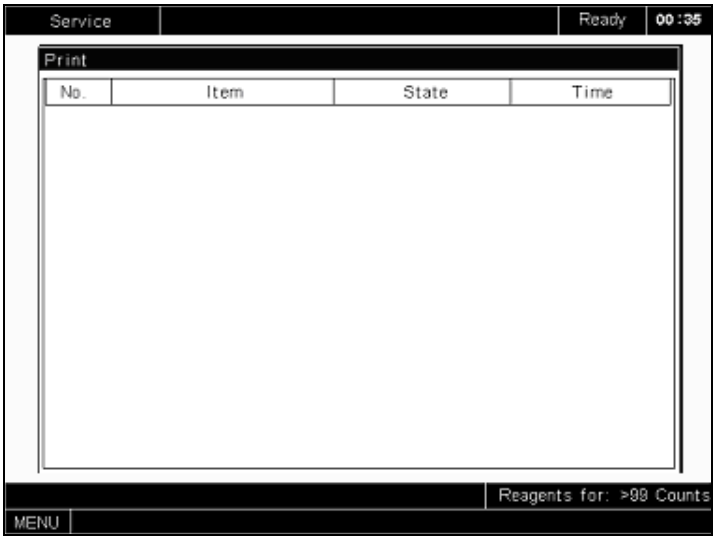


Figure 6-27 Print screen

You can perform the following operations at the ***Print*** screen:

- Press [↑] or [↓] to select the desired task.
- Press [DEL] to delete the selected task.
- Press [HELP] to display the help information.
- Press [MENU] to return to the system menu.

6.8 Adjusting Sample Probe and Replacing Probe Wipe

See Chapter 3.3.

Chapter7 Troubleshooting

The chapter deals with the codes, possible causes and solutions of the errors. If the error remains after you have tried the recommended method, call Mindray Customer Service Department or the distributor. This chapter consists of two parts, the first part dealing with the errors and assigned error codes and the second possible causes and recommended solutions.

7.1 Error Codes

The errors recorded in the log are presented in the error codes. See Table 7-1 for the correspondence between the errors and error codes.

Table 7-1 Errors and codes

Code	Error	Code	Error	Code	Error
0401	Environmental Temperature Abnormal	0402	Background abnormal	0403	HGB error
0404	HGB adjust	0405	WBC clog	0406	WBC bubbles
0407	RBC clog	0408	RBC bubbles		
0801	Communication error	0802	Scanner error	0803	Scanner communication error
1001	Printer out of paper	1002	Printer connection error	1003	Recorder communication error
1004	Recorder out of paper	1005	Recorder too hot	1006	Press bar up
2001	Lyse out	2002	Diluent expired	2003	Rinse expired
2004	Lyse expired	2005	Filter error	2006	Real-time clock error
4002	Syringe motor error	4003	Rotation motor error	4004	Elevator motor error
4005	A/D error	4008	Vacuum error	4009	Pressure error
400B	Diluent out	400C	Rinse out	400D	Waste full
8001	File error	8002	Dynamic memory error		

7.2 Solutions

This chapter presents measures to be taken when the errors occur.

7.2.1 Environmental Temperature Abnormal

Possible causes: abnormal environmental temperature or malfunctioning temperature sensor.

Solution:

Access ***Service*** → ***Status*** and check the environmental temperature. If the temperature exceeds the specified range by 15℃-35℃, you need to adjust the work environment of this analyzer so that the analyzer works in the requested environment. If the temperature is within the requested range and the error remains, call Mindray Customer Service Department or the distributor.

7.2.2 Background Abnormal

At least one parameter failed the background check.

Solution:

At the ***Count*** screen, press [F3] to do the startup procedure. If the error still remains, access ***Service*** → ***Maintenance*** and do the ***Probe cleanser cleaning*** procedure. When the cleaning is done, return to the ***Count*** screen and check the background again to see whether the error is cleared. If not, call Mindray Customer Service Department or the distributor.

7.2.3 HGB Error

HGB gain is not correct and HGB blank voltage is within 0V-3.2V or 4.9V-5V.

Solution:

Access ***Setup*** → ***Password*** to gain the administrator authority**.** Access ***Setup*** → ***Settings*** → ***Gain*** to adjust the HGB blank voltage to 3.4～4.8V (4.5V recommended). If the error still remains, turn off this analyzer and call Mindray Customer Service Department or the distributor.

7.2.4 HGB Adjustment

HGB gain is not correct and HGB blank voltage is within 3.2 - 3.4V or 4.8- 4.9V.

Solution:

Access ***Setup*** → ***Password*** to gain the administrator authority.

Access ***Setup*** → ***Settings*** → ***Gain*** to adjust the HGB blank voltage to 3.4～4.8V (4.5V recommended)**.** If the error still remains, turn off this analyzer and call Mindray Customer Service Department or the distributor.

7.2.5 WBC Clog

This error message occurs when the actual WBC count time is greater than the preset WBC count time by 2 seconds.

Possible causes: clogged aperture; inappropriate WBC count time settings or solenoid valve error.

Solution:

Access ***Service*** → ***Maintenance*** and do the ***Zap aperture*** and ***Flush aperture*** procedures**.**

After unclogging, access ***Setup*** → ***Settings*** → ***Count*** to note down the preset WBC count time. Access ***Service*** → ***Self-test*** → ***Tubing*** and test the actual WBC count time.

If the tested time differs from the preset time by less than 2 seconds, it means the unclogging is successful and you can return to the Count screen to continue the analysis. Otherwise, Access ***Service*** → ***Maintenance*** to soak the bath and tubing with probe cleanser.

When the soaking is done, access ***Setup*** → ***Settings*** → ***Count*** to note down the preset WBC count time. Access ***Service*** → ***Self-test*** → ***Tubing*** and test the actual WBC count time. If the tested time differs from the preset time by less than 2 seconds, it means the unclogging is successful and you can return to the ***Count*** screen to continue the analysis. If the difference is still greater than 2 seconds and stabilized around a certain value, access ***Setup*** → ***Settings*** → ***Count*** to change the WBC count time accordingly. After the adjustment, test the actual count time again and make sure the difference is within 2 seconds.

If the error still remains, call Mindray Customer Service Department or the distributor.

7.2.6 WBC Bubbles

This error message occurs when the actual WBC count time is less than the preset WBC count time by 2 seconds.

Possible causes:

Insufficient diluent or rinse.

Loose tubing connection;

Inappropriate WBC count time setting.

Solution:

Check if the diluent or rinse is sufficient. If not, change a new container of diluent of rinse.

Check the tubing connections. If necessary, reconnect the tubing.

If the error still remains, access ***Setup*** → ***Password*** to gain the administrator authority and then access ***Setup*** → ***Settings*** → ***Count*** and adjust the WBC count time.

If the error still remains, turn off this analyzer and call Mindray Customer Service Department or the distributor.

7.2.7 RBC Clog

This error message occurs when the actual RBC count time is greater than the

preset RBC count time by 2 seconds.

Possible causes: clogged aperture; inappropriate RBC count time settings or solenoid valve error.

Solution:

Access Service → Maintenance and do the Zap aperture and Flush aperture procedures.

After unclogging, access ***Setup*** → ***Settings*** → ***Count*** to note down the preset RBC count time. Access ***Service*** → ***Self-test*** →***Tubing*** and test the actual RBC count time.

If the tested time differs from the preset time by less than 2 seconds, it means the unclogging is successful and you can return to the Count screen to continue the analysis. Other wise, Access ***Service*** → ***Maintenance*** to soak the bath and tubing with probe cleanser.

When the soaking is done, access ***Setup*** → ***Settings*** → ***Count*** to note down the preset RBC count time. Access ***Service*** → ***Self-test*** → ***Tubing*** and test the actual RBC count time. If the tested time differs from the preset time by less than 2 seconds, it means the unclogging is successful and you can return to the ***Count*** screen to continue the analysis. If the difference is still greater than 2 seconds and stabilized around a certain value, access ***Setup*** → ***Settings*** → ***Count*** to change the RBC count time accordingly. After the adjustment, test the actual count time again and make sure the difference is within 2 seconds.

If the error still remains, call Mindray Customer Service Department or the distributor.

7.2.8 RBC Bubbles

This error message occurs when the actual RBC count time is less than the preset RBC count time by 2 seconds.

Possible causes:

1. Insufficient diluent or rinse.
2. Loose tubing connection:
3. Inappropriate RBC count time setting.

Solution:

Check if the diluent or rinse is sufficient. If not, change a new container of diluent of rinse.

Check the tubing connections. If necessary, reconnect the tubing.

If the error still remains, access ***Setup*** → ***Password*** to gain the administrator authority and then access ***Setup*** → ***Settings*** → ***Count*** and adjust the RBC count time.

If the error still remains, turn off this analyzer and call Mindray Customer Service Department or the distributor.

7.2.9 Communication Error

The received communication settings are different with the BC-2800.

Solution:

Access ***Setup*** → ***Settings*** → ***Print & comm.*** and change the communication settings accordingly.

7.2.10 Scanner Error

Too long or invalid bar code.

Solution:

Check and make sure the bar code is correct. If the error still remains, call Mindray Customer Service Department or the distributor.

7.2.11 Scanner Communication Error

Something is wrong with the communication between the scanner and the analyzer.

Solution:

Check the connection between the two devices.

7.2.12 Printer Out of Paper

Possible cause: The printing paper has run out or is not correctly installed.

Solution:

Check whether the printer is out of paper. If so, load paper to the printer; otherwise, re-install the existing paper.

If the error still remains, please contact Mindray Customer Service Department or the distributor.

7.2.13 Printer Connection Error

Check whether the printer is well connected to the analyzer.

If the error still remains, please contact Mindray Customer Service Department or the distributor.

7.2.14 Recorder Communication Error

Call Mindray Customer Service Department or the distributor.

7.2.15 Recorder Out of Paper

Possible causes: recording paper has run out or is not correctly installed.

Solution:

Check whether the recording paper has run out. If so, load new paper; if not, re-install the existing paper. If the error still remains, call Mindray Customer Service Department or the distributor.

7.2.16 Recorder Too Hot

Possible causes: the recording head overheats.

Solution:

Stop using the recorder. If the error repeats, call Mindray Customer Service Department or the distributor.

7.2.17 Press Bar Up

Possible causes: The press bar of the recorder is up.

Solution:

Push it back If the error still remains, call Mindray Customer Service Department or the distributor.

7.2.18 Lyse Out

Possible causes: insufficient lyse or wrong lyse volume setting.

Solution:

Check if there is sufficient lyse left. If so, access ***Setup*** → ***Settings*** → ***Reagents*** and adjust the remaining lyse volume; if not, change a new container of lyse.

7.2.19 Diluent Expired

The diluent has expired or its expiration date is not correctly set.

Check whether the diluent has expired. If so, change a new container of diluent; if not, access ***Setup*** → ***Settings*** → ***Reagents*** and adjust the expiration date.

7.2.20 Rinse Expired

Possible causes: rinse has expired or its expiration date is not correctly set.

Solution:

Check the rinse. If it is expired, change a new container of rinse; if not, access ***Setup*** → ***Settings*** → ***Reagents*** and adjust the expiration date.

7.2.21 Lyse Expired

The lyse has expired or its expiration date is not correctly set.

Check whether the lyse has expired. If so, change a new container of lyse**;** if not, access ***Setup*** → ***Settings*** → ***Reagents*** and adjust the expiration date.

7.2.22 Filter Error

Something is wrong with the filter of the vacuum chamber.

Solution:

Access ***Service*** → ***Self-test*** → ***Tubing*** and test the filter. The error is cleared if the result is normal. If not, call Mindray Customer Service Department or the distributor.

7.2.23 Real-Time Clock Error

Something is wrong with the clock.

Access ***Setup*** → ***Settings*** → ***Date & Time*** and set the time and date and restart the analyzer to enable the new settings. If the error still remains, call

Mindray Customer Service Department or the distributor.

7.2.24 Syringe Motor Error

Something is wrong with the motor controls the syringe that aspirates/dispenses samples and reagents.

Solution:

Access ***Service → Self-test → Machine*** and test the motor The error will be cleared if the result is normal; otherwise, call Mindray Customer Service Department or the distributor.

7.2.25 Rotation Motor Error

Something is wrong with the motor that rotates the sample probe.

Access ***Service →Self-test → Machine*** and test the motor. The error will be cleared if the result is normal. Otherwise, call Mindray Customer Service Department or the distributor.

7.2.26 Elevator Motor Error

Something is wrong with the motor that controls elevation of the sample probe.

Access ***Service → Self-test → Machine*** and test the motor. The error will be cleared if the result is normal. Otherwise, call Mindray Customer Service Department or the distributor.

7.2.27 A/D Error

Something is wrong with the A/D converter on the CPU board.

Solution:

Access ***Service → Self-test → Circuit***. Test the A/D interrupt.

The error will be cleared if the test result is normal. Otherwise, call Mindray Customer Service Department or the distributor.

7.2.28 Vacuum Error

The system does not reach the expected vacuum within the given time.

Solution:

Access ***Service → Self-test → Tubing*** and test the vacuum. The error will be cleared if the result is normal; otherwise, call Mindray Customer Service Department or the distributor.

7.2.29 Pressure Error

The vacuum chamber does not reach the expected pressure within the given time.

Solution:

Access ***Service → Self-test → Tubing*** and test the pressure. The error will be cleared if the result is normal; otherwise, call Mindray Customer Service Department or the distributor.

7.2.30 Diluent Out

Possible causes: insufficient diluent or wrong diluent volume setting.

Solution:

Check if there is sufficient diluent left. If so, access ***Setup*** → ***Settings*** → ***Reagents*** and adjust the remaining diluent volume; if not, change a new container of diluent.

7.2.31 Rinse Out

Possible causes: insufficient rinse or wrong rinse volume setting.

Solution:

Check if there is sufficient rinse left. If so, access *Setup* → *Settings* → *Reagents* and adjust the remaining rinse volume; if not, change a new container of rinse.

7.2.32 Waste Full

The waste container is full.

Empty the container, or change a new container to receive the waste and re-set the waste container volume.

7.2.33 File Error

Something is wrong with file saving.

Turn off the analyzer and call Mindray Customer Service Department or the distributor.

7.2.34 Dynamic Memory Error

Something is wrong with the system memory.

Turn off the analyzer and call Mindray Customer Service Department or the distributor.

Chapter8 List of Spare parts

P/N	Description
0000-10-10891	Keyboard
0000-10-10907	Disk-on-module (32M)
0010-10-12316	Hitachi STN screen (640X480)
0200-10-05528	Bearing (for syringes)
0200-20-05530	Plunger
1800-30-19455	Indicator board
2000-20-03124	Ruby Red Cell Counter 80um RB-22084
2800-20-32054	START key
2800-30-32057	Recorder assembly
2800-20-28674	Keypad overlay
2800-20-28696	Syringe press plate
2800-20-28699	Plunger pin
2800-20-28700	7.5ml bolt
2800-20-28701	Upper shielding plate for the analog board
2800-20-28702	Lower shielding plate for the analog board
2800-20-28719	Guide bushing
2800-20-28724	Sealing bushing
2800-20-28725	Sealing ring
2800-20-28739	Connection wires for the indicator board
2800-20-28740	LCD adaptor wire(flexible FFC)
2800-20-28754	Connection wire between the keypad and the recorder
2800-20-28757	Connection wire of the position sensor
2800-20-28770	Connection wire for the LCD
2800-20-28843	Body of 7.5ml syringe
2800-20-28844	Flange of 7.5ml syringe
2800-20-28845	Locking nut of 7.5ml syringe
2800-20-28846	Body of 50μl syringe
2800-20-28847	Nut of 50μl syringe
2800-20-28848	Bolt of 50μl syringe
2800-20-28849	Connection wire of inverter
2800-21-28728	Shielding box cover assembly
2800-21-28788	Shielding box assembly
2800-30-28650	CPU board
2800-30-28652	Analog board
2800-30-28654	Driving board
2800-30-28664	Keypad

2800-30-28668	Volumemetric metering board
2800-30-28670	Power board
2800-30-28715	Screen assembly
2800-30-28716	Sampling assembly
2800-30-28746	LCD adaptor
2800-30-28767	Bath assembly
2800-30-28778	Syringe assembly
2800-30-28779	7.5ml syringe assembly
2800-30-28780	50ul syringe assembly
2800-30-28789	Bath mount assembly
2800-30-28815	HGB mount assembly
2800-30-28817	CAP component for LYSE
2800-30-28818	CAP component for DILUENT
2800-30-28819	CAP component for RINSE
2800-30-28839	Waste tubing assembly
3001-10-07252	Vacuum Pump
3001-20-07247	Localizer
3001-21-07182	Cap for LYSE
3001-30-06957	Probe wipe
59BR-10-08830	Thermal head
M90-000130---	O-RING (6×1)
M90-100054---	O-RING Φ2.00X1.80
M90-100069---	P/N:X420-1 10-32 Special Tapered Thread To 3/32'
M90-100101---	Y-shaped O-RINGE
TR6A-20-09940	Recorder door
TR6D-30-16662	TR60-D drive board
3001-10-07048	Rotation motor
3001-10-07049	Elevator motor
3001-10-07059	Sample probe
3001-10-07252	Diaphragm pump
3001-20-07072	Transformer
3001-20-07245	Three-way valve (ASCO)
3001-20-07246	Two-way valve (ASCO)
3001-30-06880	Sample probe assembly
3001-30-07021	Vacuum chamber assembly
900E-10-04913	Inverter
3001-10-07068	Tubing(ID1/16’, OD1/8’)
M90-100035---	Tubing(ID0.02, OD0.06)
M90-100071---	Tubing(ID3/32’, OD5/32’)

Appendix BC-2800 Error Message

CODE	Error Message Information
0401	Envir. Temp. Abnormal
0402	Background abnormal
0403	HGB error
0404	HGB adjust
0405	WBC clog
0406	WBC bubbles
0407	RBC clog
0408	RBC bubbles
0801	Communication error
0802	Scanner error
0803	Scanner communication error
1001	Printer out of paper
1002	Printer connection error
1003	Recorder communication error
1004	Recorder out of paper
1005	Recorder too hot
1006	Press bar up
2001	Lyse out
2002	Diluent expired
2003	Rinse expired
2004	Lyse expired
2005	Filer error
2006	Real-time clock error
4002	Syringe motor error
4003	Rotation motor error
4004	Elevator motor error
4005	A/D error
4008	Vacuum error
4009	Press error
400B	Diluent out
400C	Rinse out
400D	Waste full
8001	File error
8002	Dynamic memory error

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